TOTAL MAXIMUM DAILY LOADS (TMDLs)

For

Fecal Coliform

In

Oconee River Basin

February 2002

United States Environmental Protection Agency

Region 4 serving the southeast

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing Total Maximum Daily Loads (TMDLs) for fecal coliform for §303(d) listed stream segments in the Oconee River Basin. Subsequent actions must be consistent with this TMDL.

Beverly H. Banister, Director Water Management Division	Date

TABLE OF CONTENTS

¾ ¾

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

BMP	Best Management Practices
CFS	Cubic Feet per Second
DEM	Digital Elevation Model
DMR	Discharge Monitoring Report
DNR	Department of Natural Resources
DWPC	Division of Water Pollution Control
EPA	Environmental Protection Agency
EPD	Environmental Protection Division (State of Georgia)
GIS	Geographic Information System
HSPF	Hydrological Simulation Program - FORTRAN
HUC	Hydrologic Unit Code
LA	Load Allocation
MGD	Million Gallons per Day
MOS	Margin of Safety
MPN	Most Probable Number
MRLC	Multi-Resolution Land Characteristic
NPDES	National Pollutant Discharge Elimination System
NPSM	Nonpoint Source Model
NRCS	Natural Resources Conservation Service
Rf3	Reach File 3
RM	River Mile
STORET	STORage RETrieval database
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WCS	Watershed Characterization System
WLA	Waste Load Allocation

SUMMARY
Total Maximum Daily Loads (TMDLs)
303(d) Listed Streams in Oconee River Basin - HUC 03070101 and HUC 03070102

State: Georgia
Counties: Hall, Gwinnett, Madison, Jackson, Barrow, Clarke, Walton, Oconee, Morgan, Newton, Greene, Oglethorpe, Jasper, Putnam, Hancock, Jones, Baldwin, Washington, Twiggs, Wilkinson, Johnson, Laurens, Treutlen, Dodge, Wheeler, Montgomery, and Bleckley

Major River Basin: Oconee River

Constituent(s) of Concern: Fecal Coliform Bacteria

Summary of 303(d) Listed Waterbody Information and Allocation by Stream Segment

Stream Name	Segment Description	Hydrologic Unit(s)	Use Classification	Segment Length (miles)	Drainage Area (miles^2)	WLA (#/30 days)	LA (#/30 days)	MOS (#/30 days)	TMDL (#/30 days)	Percent Reduction
Apalachee River	Marburg Creek to Lake Oconee	030701010805 030701010901 030701010905 030701010906	Fishing	35	276	9.12×10^{12}	1.97×10^{13}	2.19×10^{12}	2.28×10^{13}	73
Apalachee River	Williamson Creek to Marburg Creek	030701010802 030701010804	Fishing	7	69	0	3.85×10^{12}	4.28×10^{11}	4.28×10^{12}	77
Beaverdam Creek	Oliver creek to Lake Oconee	030701011102 030701011103	Fishing	4	29	0	1.97×10^{13}	2.19×10^{12}	2.19×10^{13}	84
Big Cedar Creek	Hog Creek to Lake Sinclair	030701011704	Fishing	11	139	0	1.25×10^{14}	1.39×10^{13}	1.39×10^{14}	80
Big Indian Creek	I-20 to Little Indian Creek	030701011405 030701011406	Fishing	11	39	1.14×10^{10}	3.52×10^{13}	3.91×10^{12}	3.91×10^{13}	73
Big Sandy Creek	Porter Creek to Oconee River	030701020701 030701020705	Fishing	14	306	5.00×10^{9}	7.59×10^{11}	8.43×10^{10}	8.48×10^{11}	89
Carr Creek	Headwaters to North Oconee River	030701010505	Fishing	2	3	0	1.14×10^{13}	1.27×10^{12}	1.27×10^{13}	76
Cedar Creek	Headwaters to Oconee River	030701010601	Fishing	4	5	4.55×10^{11}	1.14×10^{13}	1.27×10^{12}	1.31×10^{13}	76
Cedar Creek	Headwaters to Winder Reservoir	030701010204	Fishing	4	14	0	1.13×10^{12}	1.26×10^{11}	1.26×10^{12}	88

Stream Name	Segment Description	Hydrologic Unit(s)	Use Classification	Segment Length (miles)	Drainage Area (miles^2)	WLA (#/30 days)	LA (#/30 days)	MOS (#/30 days)	TMDL (#/30 days)	Percent Reduction
East Fork Trail Creek	Headwaters to West Fork Trail Creek	030701010505	Fishing	3	6	1.32×10^{10}	8.53×10^{12}	9.48×10^{11}	9.49×10^{12}	76
Little River	Glady Creek to Lake Sinclair	030701011501 030701011503	Fishing	8	90	2.11×10^{11}	1.69×10^{15}	1.87×10^{14}	1.87×10^{15}	50
Little River	Shoal Creek to Gap Creek	030701011402 030701011404	Fishing	14	298	1.02×10^{11}	3.56×10^{13}	3.95×10^{12}	3.96×10^{13}	73
Little River	Social Circle to Nelson Creek	030701011401	Fishing	3	27	1.02×10^{11}	2.86×10^{13}	3.18×10^{12}	3.19×10^{13}	59
Little Sugar Creek	Headwaters to Lake Oconee	030701011003	Fishing	9	33	0	5.39×10^{13}	5.99×10^{12}	5.99×10^{13}	74
Marburg Creek	Masseys Lake to Apalachee River	030701010803	Fishing	7	26	1.41×10^{11}	2.77×10^{12}	3.08×10^{11}	3.22×10^{12}	77
Middle Oconee River	Big Bear Creek to McNutt Creek	030701010307	Fishing	12	253	1.39×10^{12}	1.94×10^{14}	2.15×10^{13}	2.17×10^{14}	22
Middle Oconee River	Mulberry River to Big Bear Creek	030701010301	Fishing	11	43	2.28×10^{10}	6.27×10^{13}	6.97×10^{12}	6.97×10^{13}	43
Mulberry River	Little Mulberry River to Middle Oconee	030701010204 030701010205	Fishing	18	157	0	1.94×10^{13}	2.15×10^{12}	2.15×10^{13}	44
North Oconee River	Bordens Creek to Curry Creek	030701010406	Fishing	8	141	2.03×10^{10}	1.56×10^{13}	1.73×10^{12}	1.73×10^{13}	60
North Oconee River	Chandler Creek to Bordens Creek	030701010402 030701010404 030701010406	Fishing	12	103	2.03×10^{10}	1.56×10^{13}	1.73×10^{12}	1.73×10^{13}	60
North Oconee River	Jackson County to Sandy Creek	030701010505	Fishing/ Drinking Water	5	208	8.63×10^{10}	3.94×10^{13}	4.38×10^{12}	4.39×10^{13}	60
North Oconee River	Sandy Creek to Trail Creek	030701010501	Fishing/ Drinking Water	2	276	8.63×10^{10}	3.94×10^{13}	4.38×10^{12}	4.39×10^{13}	60

Stream Name	Segment Description	Hydrologic Unit(s)	Use Classification	Segment Length (miles)	Drainage Area (miles^2)	WLA (#/30 days)	LA (#/30 days)	MOS (#/30 days)	TMDL (#/30 days)	Percent Reduction
North Oconee River	Trail Creek to Oconee River	030701010505	Fishing	8	301	2.56×10^{12}	1.08×10^{14}	1.20×10^{13}	1.22×10^{14}	72
Oconee River	Barnett Shoals to Lake Oconee	030701010606 030701010701	Fishing	16	631	4.55×10^{12}	5.23×10^{14}	5.81×10^{13}	5.86×10^{14}	35
Oconee River	Confluence of North & Middle Oconee Rivers	030701010601	Fishing	4	773	4.56×10^{12}	3.77×10^{14}	4.19×10^{13}	4.24×10^{14}	49
Oconee River	Long Branch to Turkey Creek	030701020901	Fishing	9	4454	1.30×10^{13}	5.77×10^{13}	6.41×10^{12}	7.71×10^{13}	25
Richland Creek	Interstate 20 to Beaverdam Creek	030701011104	Fishing	8	53	0	2.95×10^{13}	3.28×10^{12}	3.28×10^{13}	88
Rooty Creek	Rd. S926 Eatonton to Little Creek	030701011803	Fishing	9	46	6.26×10^{10}	3.99×10^{12}	4.44×10^{11}	4.50×10^{12}	74
Tanyard Creek	Upstream North Oconee River	030701010505	Fishing	1	1	0	1.10×10^{13}	1.22×10^{12}	1.22×10^{13}	76
Town Creek	Hwy. 15 to Richland Creek	030701011101	Fishing	4	9	2.27×10^{11}	1.91×10^{12}	2.13×10^{11}	2.35×10^{12}	97
Turkey Creek	Horse Branch to Rocky Creek	030701021103	Fishing	10	123	9.48×10^{10}	6.13×10^{11}	6.81×10^{10}	7.76×10^{11}	51
Turkey Creek	Rocky Creek to Oconee River	030701021104 030701021105	Fishing	11	359	1.12×10^{11}	8.03×10^{11}	8.92×10^{10}	1.00×10^{12}	62

Note: All future NPDES facilities discharging fecal coliform bacteria shall not cause or contribute to water quality impairment.

Summary of 1998 303(d) Listed TMDLs in Oconee River Basin

Stream Name	Segment Description	Use Classification	Segment Length (miles)	New TMDL
E. T. Creek	Gainesville	Fishing	1	Walnut Creek
Anne Court Branch	Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
Brooklyn Creek	Athens	Fishing	2	Middle Oconee River (Bear Creek to McNutt Creek)
Kingswood Branch	Tributary to McNutt Creek, Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
Mitchell Bridge Branch	Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
North Bypass Branch	Tributary to North Oconee River, Athens	Fishing	2	North Oconee River (Sandy Creek to Trail Creek)
Carver Branch	Tributary to Trail Creek, Athens	Fishing	1	East Fork Trail Creek
West Fork Trail Creek	Athens	Fishing	3	East Fork Trail Creek
Trail Creek	Athens	Fishing	2	East Fork Trail Creek
Cloverhurst Branch	Athens	Fishing	2	Tanyard Creek
Fishing Creek	McWhorter Branch to Lake Oconee	Fishing	4	Rooty Creek (Tributary to Lake Oconee)
Greenbriar Creek	Salem Scull Shoals Road to Lake Oconee	Fishing	Fully Supporting on GA 2000 305(b) Report	Rooty Creek (Tributary to Lake Oconee)
Towns Creek	Penfield to Lake Oconee	Fishing	7	Rooty Creek (Tributary to Lake Oconee)
Sugar Creek	Upstream of Lake Oconee	Fishing	7	Little Sugar Creek
Richland Creek	Greensboro	Fishing	9	Richland Creek (Interstate 20 to Beaverdam Creek)

Applicable Water Quality Standard for Drinking Water and Fishing use classifications:

Section 391-3-6-.03 (6) of the *State of Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6 Revised, July, 2000:*

May through October - fecal coliform is not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200 per 100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. November through April - fecal coliform is not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample. The geometric mean standard is the target value for the TMDLs

TMDL Development - Analysis/Modeling:

The Hydrologic Simulation Program FORTRAN (HSPF) watershed model was used to develop these TMDLs. An hourly time step was used to simulate hydrologic and water quality conditions with results expressed as daily averages. A simulation period of 10 years was used to assess the water quality standards for these TMDLs representing a range of hydrologic and meteorological conditions.

FECAL COLIFORM TOTAL MAXIMUM DAILY LOADS (TMDLs) for 303(d) listed stream segments in the OCONEE RIVER BASIN

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions. This allows water quality based controls to be developed and implemented in an effort to reduce pollution, and restore and maintain compliance with water quality standards.

The TMDLs developed in this report represent the first phase of a long-term process to reduce fecal coliform loading to meet water quality standards in the Oconee River basin. The reduction scenario proposed for the TMDLs represent one possible allocation scenario that can be used to meet water quality standards. Stakeholders in the impaired watersheds may choose other allocation scenarios to meet the required load reductions. Implementation strategies will be reviewed and the TMDLs will be refined as necessary in the next phase (next five-year cycle). The phased approach will support progress toward water quality standards attainment in the future. In accordance with USEPA TMDL guidance (EPA, 1991), these TMDLs may be revised based on results of future monitoring and source characterization data efforts.

In January 2002, EPD finalized fecal coliform TMDLs for several headwaters tributaries to the Mulberry River, for which a TMDL is prescribed in this report. The TMDLs developed by EPD are in the Upper Oconee Basin and include: Town Creek (Hancock and Baldwin counties), Tributary 2 to Allen Creek, Tributary 5 to Allen Creek, Tributary 7 to Allen Creek, Tributary 8 to Allen Creek, Allen Creek, North Walnut Creek (2 segments), Tributary to North Walnut Creek, and Walnut Creek. The TMDLs for these streams can be found in the EPD report entitled *"Total Maximum Daily Loads (TMDLs) for Fecal Coliform in 303(d) Listed Streams in the Oconee River Basin"* (EPD, 2002). For consistency in the development of TMDLs for Mulberry River, EPA used the assumptions and models developed by EPD for the above listed streams.

In 1998, EPA finalized fecal coliform TMDLs for 15 streams in the Upper Oconee River Basin. Many of these streams are tributaries of larger watersheds for which a TMDL has been developed in this report. The TMDL of the larger watershed supercedes the TMDL finalized in 1998. Listing information for these streams as reported on the 1996 303(d) list, as well as the TMDL that replaces the one developed in 1998, are shown in Table 1. The locations of the streams with respect to TMDLs described in this report are shown in Figure 3.

Table 1. 1998 303(d) Listed TMDLs in Oconee River Basin

Stream Name	Segment Description	Use Classification	Segment Length (miles)	New TMDL
E. T. Creek	Gainesville	Fishing	1	Walnut Creek
Anne Court Branch	Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
Brooklyn Creek	Athens	Fishing	2	Middle Oconee River (Bear Creek to McNutt Creek)
Kingswood Branch	Tributary to McNutt Creek, Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
Mitchell Bridge Branch	Athens	Fishing	1	Middle Oconee River (Bear Creek to McNutt Creek)
North Bypass Branch	Tributary to North Oconee River, Athens	Fishing	2	North Oconee River (Sandy Creek to Trail Creek)
Carver Branch	Tributary to Trail Creek, Athens	Fishing	1	East Fork Trail Creek
West Fork Trail Creek	Athens	Fishing	3	East Fork Trail Creek
Trail Creek	Athens	Fishing	2	East Fork Trail Creek
Cloverhurst Branch	Athens	Fishing	2	Tanyard Creek
Fishing Creek	McWhorter Branch to Lake Oconee	Fishing	4	Rooty Creek (Tributary to Lake Oconee)
Greenbriar Creek	Salem Scull Shoals Road to Lake Oconee	Fishing	Fully Supporting on GA 2000 305(b) Report	Rooty Creek (Tributary to Lake Oconee)
Towns Creek	Penfield to Lake Oconee	Fishing	7	Rooty Creek (Tributary to Lake Oconee)
Sugar Creek	Upstream of Lake Oconee	Fishing	7	Little Sugar Creek
Richland Creek	Greensboro	Fishing	9	Richland Creek (Interstate 20 to Beaverdam Creek)

2.0 WATERSHED DESCRIPTION

The Oconee River watershed (HUC 03070101 and HUC 03070102) is located in Central Georgia and falls within the Level III Piedmont (45) and Southeastern Plains (65) ecoregions (Figure 1, EPA, 2000). The Upper Oconee River watershed (above Lake Sinclair) is located primarily in the Level IV Southern Outer Piedmont (45b) subecoregion, with small portions of the headwaters extending up into the Southern Inner Piedmont (45a) subecoregion. The Lower Oconee River watershed (below Lake Sinclair) is a multifaceted watershed with portions of the watershed located in the Level IV Southern Outer Piedmont (45b), the Sand Hills (65c), the Coastal Plain Red Uplands (65k) and the Atlantic Southern Loam Plains (65l). There is also as a corridor, running the length of the Lower Oconee River and extending (approximately) one half to two miles inland on each side of the river, which lies in the Southeastern Floodplains and Low Terraces (65p) subecoregion. Typical characteristics for these subecoregions are as follows:

- Southern Inner Piedmont (45a) - this region contains mostly rolling to hilly upland; mainly pine and hardwood woodlands and fine textured, low nutrient and low organic content soils.

- Southern Outer Piedmont (45b) - this region contains lower elevations and less relief than 45a, with mostly red clayey soils; southern most boundary occurs at the fall line; major forest type is loblolly short-leafed pine.

- Sand Hills (65c) – rolling to hilly, highly dissected coastal plain belt; generally low nutrient sand and clay soils.

- Coastal Plain Red Uplands (65k) - this region contains mostly well drained soils composed of red sand and clay; the majority of the land is utilized as cropland or pasture.

- Atlantic Southern Loam Plains (65l) - this region contains soils ranging from poorly drained to excessively drained; longleaf pine, oak and some distinctive evergreen shrubs are common vegetation.

- Southeastern Floodplains and Low Terraces (65p) – this region contains large sluggish rivers and backwaters with ponds, swamps and oxbow lakes; terraces are typically covered by oak forests, while forests of bald cypress and water tupelo grow in the swamps and river areas.

The Oconee River basin contains approximately 8,167 miles of Reach File 3 (Rf3) level streams and drains a total area of approximately 5,326 square miles. Watershed land use distribution is based on the Multi-Resolution Land Characteristic (MRLC) databases derived from Landsat Thematic Mapper digital images from the period 1990-1994. Land use in the Oconee River Basin is summarized in Table 1. Figures 2 and 3 show MRLC land use for the watersheds containing all of the 303(d) listed segments for which a TMDL has been developed in this report. Land use data in some portions of the Upper Oconee watersheds in proximity to the Athens area was modified using a process developed by Aqua Terra, Inc., consultants. This methodology reclassified MRLC land use data for some forested areas from "forested" to "built up" based on an analysis of the degree or level of development adjacent to that particular area. This approach was demonstrated to produce a more accurate land use analysis when compared to recent land use data collected and compiled using more detailed and accurate methods than were used in developing the MRLC data. This adjustment was justifiable only for rapidly developing areas around Athens.

For purposes of calculating fecal coliform loading rates, the MRLC data were summarized into six broad categories: urban pervious, urban impervious, cropland, pastureland, forest and, wetlands. Fecal coliform loading rates were assigned to land coverages based on literature values (NCSU, 1994; EPA, 2001). The loadings from forest and wetlands were assumed to be background. The loadings from urban, cropland, and pasturelands were subject to reductions in the TMDL analysis.

3.0 PROBLEM DEFINITION

EPA Region 4 approved Georgia's final 2000 303(d) list on August 28, 2000. This 303(d) list was then updated for the Altamaha, Ocmulgee, and Oconee River Basins and was finalized and approved by EPA Region 4 in June 2001. The list identified the waterbodies for the Oconee River Basin shown in Table 2, as either not supporting or partially supporting designated use classifications, due to exceedence of water quality standards for fecal coliform bacteria. Fecal coliform bacteria are used as an indicator of the potential presence of pathogens in a stream. The objective of this study is to develop fecal coliform TMDLs for 303(d) listed waterbodies in the Oconee River basin.

Pursuant to the Consent Decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.), the State or EPA shall develop TMDLs for all waterbodies on the State of Georgia's current 303(d) List by a prescribed schedule. On June 30, 2001, The Georgia Environmental Protection Division (EPD) developed 11 TMDLs in this Basin group that were impaired for fecal coliform bacteria. The TMDLs for the remaining 32 listed segments are included in this report.

4.0 TARGET IDENTIFICATION

Each of the 303(d) listed waterbodies in the Oconee River Basin for which a fecal coliform TMDL is being developed has a designated use classification of either fishing or drinking water. The fecal coliform water quality criteria for protection of the drinking water and fishing use classifications is established by the *State of Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6 Revised, July, 2000,* and will be used as the target level for fecal coliform TMDL development for all listed segments in the Oconee River basin.

Section 391-3-6-.03 (6) of the *State of Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6 Revised, July, 2000,* states that during the months of May through October, when water contact recreation activities are expected to occur, fecal coliform is not to exceed a geometric mean of 200 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours. Should water quality and sanitary studies show fecal coliform levels from non-human sources exceed 200/100 ml (geometric mean) occasionally, then the allowable geometric mean fecal coliform shall not exceed 300 per 100 ml in lakes and reservoirs and 500 per 100 ml in free flowing freshwater streams. For the months of November through April, fecal coliform is not to exceed a geometric mean of 1,000 per 100 ml based on at least four samples collected from a given sampling site over a 30-day period at intervals not less than 24 hours and not to exceed a maximum of 4,000 per 100 ml for any sample.

The geometric mean criterion of 200 counts/100mL is the primary target value for the TMDLs. The State of Georgia does not have an instantaneous fecal coliform criterion for the summer months when water contact activities are expected to occur. Therefore, the geometric mean is the only applicable criterion to show compliance with the designated use. The TMDLs are expressed in terms of a 10-year geometric mean plot. The purpose of the ten-year period is to show that the proposed reductions comply with the geometric mean criteria for all seasons.

To address uncertainty in the model, a margin of safety (MOS) of 10 percent of the load allocation (LA) is included in the TMDLs. The MOS is taken from the LA component as this represents the largest source of loading from the watershed. In addition, an explicit MOS was included in several of the TMDLs by reducing the simulated peak geometric mean concentration during the critical period to a value less than the target. As an example, in the Middle Oconee TMDL, the simulated peak concentration for the allocation scenario was reduced to about 160 counts/100mL, or 40 counts below the criteria of 200 counts/100mL. This represents a MOS of about 20 percent.

5.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Compliance with the applicable fecal coliform water quality criteria was assessed for each of the 303(d) listed streams, based on monitoring data collected from the monitoring stations listed in Table 3.

Water quality data collected during calendar year 1999 for the 303(d) listed stream segments are summarized in Table 4. A geometric mean in excess of 200 counts per 100 milliliters during the period May – October, or in excess of 1000 counts per 100 milliliters during the period November – April, provides a basis for adding a stream segment to the 303(d) List. A single sample in excess of 4000 counts per 100 milliliters can also provide a basis for adding a stream segment to the 303(d) List. Stream segments that do not have 1999 monitoring data exceeding the above geometric mean or single sample criterion were placed on the 303(d) List as a result of data collected prior to 1999.

6.0 SOURCE ASSESSMENT

An important part of the TMDL analysis is the identification of source categories, source subcategories, or individual sources of fecal coliform bacteria in the watershed and the amount of loading contributed by each of these sources. Sources are broadly classified as either point or non-point sources.

A point source can be defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Point source discharges of industrial wastewater and treated sanitary wastewater must be authorized by National Pollutant Discharge Elimination System (NPDES) permits. NPDES permitted facilities discharging treated sanitary wastewater are considered primary point sources of fecal coliform bacteria.

Non-point sources of fecal coliform bacteria are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of fecal coliform bacteria on land surfaces and washoff as a result of storm events. Typical non-point sources of fecal coliform bacteria include:

- Wildlife
- Land application of agricultural manure
- Livestock grazing
- Leaking septic systems
- Urban development (including leaking sewer collection lines)
- Animals having access to streams

6.1 Point Sources

There are approximately 54 permitted point source discharges of fecal coliform bacteria located in the drainage areas of the 303(d) listed stream segments. These facilities are primarily municipal water pollution control plants (WPCP). The average discharge flow and flow-weighted average fecal coliform loading for the NPDES facilities, as calculated from CY1999 Discharge Monitoring Report (DMR) data were provided by EPD and are summarized in Table 5. Design flows, and fecal coliform loading based on monthly fecal coliform permit limits, are also provided in Table 5. In the water quality models, the fecal coliform loading rates from these facilities was calculated using the design flow and the permit concentration of 200 counts/ 100 ml. This load is considered a conservative estimate of the WLA component as most of the NPDES facilities discharging fecal coliform use disinfection prior to discharge.

6.2 Nonpoint Source Assessment

6.2.1 Wildlife

Wildlife deposit feces onto land surfaces where it can be transported during storm events to nearby streams. In the water quality model, the wildlife fecal coliform contribution is accounted for in the deer population. The deer population is estimated to be 30 to 45 animals per square mile in this area (Georgia WRD, 1999). The upper limit of 45 deer per square mile has been chosen to account for deer and all other wildlife present in the watershed. It is assumed that the wildlife population remains constant throughout the year, and that wildlife is uniformly distributed on all land classified in the MRLC database as forest, pasture, cropland, and wetlands. . The fecal coliform concentration assigned to deer is approximately 5.0×10^{8} counts/animal/day (EPA, best professional judgment). The resulting load attributed to wildlife is about 3.5×10^{7} counts/acre-day.

6.2.2 Agricultural Animals

Agricultural animals are also a potential source of several types of fecal coliform loading to streams in the Oconee River basin. Livestock data are reported by county and published by the USDA in the Census of Agriculture (USDA, 1997). The available livestock data include population estimates for cattle, beef cows, dairy cows, hogs, sheep, and poultry (broilers and layers). Livestock data for the counties comprising the 303-(d) listed streams are shown in Table 6. Cattle numbers reported in the census data also represent other breeds of cattle and calves in addition to dairy and beef. Assumptions regarding agricultural animals and resource management practices were provided by NRCS (USDA, 2001) and are summarized as follows:

- As with wildlife, agricultural livestock grazing on pastureland or forestland deposit their feces onto land surfaces where it can be transported during storm events to nearby streams.

- Confined livestock operations also generate manure, which can be applied to pastureland and cropland as a fertilizer. Processed agricultural manure from confined hog, dairy cattle, and some poultry operations is generally collected in lagoons and applied to land surfaces during the growing season, at rates which often vary on a monthly basis. Data sources for agricultural animals are tabulated by county and are based on information obtained from the Census of Agriculture (USDA, 1997). Fecal coliform loading rates for livestock in the watershed are estimated to be: 1.06×10^{11} counts/day/beef cow, 1.24×10^{10} counts/day/hog, 1.04×10^{11} counts/day/dairy cow, 1.38×10^{8} counts/day/layer chicken, and 1.22×10^{10} counts/day/sheep (NCSU, 1994).

- Agricultural livestock and other unconfined animals (i.e., deer and other wildlife) also often have direct access to streams that pass through pastures. Feces deposited into these streams by grazing animals are included in the water quality model as a point source having constant flow and concentration. To calculate the amount of fecal coliform bacteria introduced into streams by cattle, it is assumed that 50 percent of the beef cows in the watershed have access to the streams, and of those, 25 percent defecate in or near the stream banks during a portion of the day (personal communication, EPA, Georgia Agribusiness Council, NRCS, University of Georgia, et. al.). The resulting percentage of time fecal coliform bacteria is discharged into the stream from grazing animals is 0.025 percent.

Assumptions regarding manure management practices for specific agricultural livestock operations areas are similar to those used to develop the TMDLs for the South Georgia Four Basins in 2000 and include:

- Poultry litter is normally piled for a period before it is applied to the land. Within the Oconee River basin it is estimated that approximately 60 percent of poultry litter (i.e., broiler and layers) is applied to pastureland and 40 percent is applied to cropland. It is assumed that the poultry litter is applied primarily during the period between March and October (inclusive), and that application rates vary monthly.

- Hog farms in the Oconee River basin operate by confining the animals or allowing them to graze in small pastures or pens. It is assumed that all of the hog manure produced by either farming method is applied to available pastureland, with negligible amounts applied to cropland. Application rates of hog manure to pastureland vary monthly according to management practices. Manure is applied during the period between March and October (inclusive).

- On dairy farms, the cows are confined for a limited period each day during which time they are fed and milked. This is estimated to be four hours per day for each dairy cow. It is assumed that 60 percent of manure collected during confinement is applied to pastureland and 40 percent is applied to cropland. It is also assumed that the dairy cow manure is applied during the period between February and October (inclusive), as well as in November. Application rates vary monthly according to management practices.

- Beef cattle are assumed to be in pasture year round. Therefore, beef cow manure is applied only to pastureland and at a constant monthly rate. This rate varies between watersheds, as the rate is a function of the number of beef cows in the watershed.

6.2.3 Leaking Septic Systems

Some fecal coliform loading in the Oconee River basin may be attributed to failure of septic systems and illicit discharges of raw sewage. Loading rates are based on estimates from county census data of people in each listed stream watershed utilizing septic systems and literature values for fecal coliform concentrations in human waste. Septic population estimates were updated based on a county-by-county survey conducted by EPD in April-May 2001. It is estimated that there are approximately 2.37 people per household on septic systems (EPA, best professional judgment). For modeling purposes, it is assumed that ten percent of the septic systems in the watershed leak. Leaking septic systems are included in the water quality model as a point source having constant flow and concentration. The average fecal coliform concentration of the septic system wastewater reaching a stream was assumed to be 1 x 10^4 counts per 100 ml (EPA, 2001).

6.2.4 Urban Development

Fecal coliform loading from urban areas is potentially attributable to multiple sources including storm water runoff, leaks and overflows from sanitary sewer systems, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals. Urban runoff and storm water processes are considered to be significant contributors to fecal coliform concentrations in some Oconee River subwatersheds.

7.0 ANALYTICAL APPROACH

Establishing the relationship between in-stream water quality and source loading is an important component of TMDL development. It allows the determination of the relative contribution of sources to total pollutant loading and the evaluation of potential changes to water quality resulting from implementation of various management options. This relationship can be developed using a variety of techniques ranging from qualitative assumptions based on scientific principles to numerical computer modeling. In this section, the numerical modeling techniques developed to simulate fecal coliform bacteria fate and transport in the watershed are discussed.

7.1 Model Selection

A dynamic computer model was selected for fecal coliform analysis in order to: a) simulate the time varying nature of fecal coliform deposition on land surfaces and transport to receiving waters; b) incorporate seasonal effects on the production and fate of fecal coliform bacteria; and c) identify the critical condition for the TMDL analysis. Several computer based tools were also utilized to generate input data for the model.

The Nonpoint Source Model (NPSM) is a watershed model capable of simulating nonpoint source runoff and associated pollutant loadings, account for point source discharges, and performing flow and water quality routing through stream reaches. NPSM is based on the Hydrologic Simulation Program - Fortran (HSPF). In these TMDLs, NPSM was used to simulate point source discharges, simulate the deposition and transport of fecal coliform bacteria from land surfaces, and compute the resulting water quality response. In-stream decay of fecal coliform bacteria is included in the model at a rate of 0.048 per hour. This rate represents the median value reported in the literature (EPA, 1985), that reports decay rates from 0.008 per hour to 0.13 per hour.

In addition to NPSM, the Watershed Characterization System (WCS), a geographic information system (GIS) tool, was used to display, analyze, and compile available information to support water quality model simulations for the Oconee River basin (EPA, 2001). This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics. Results of the WCS characterization are input to a spreadsheet developed by Tetra Tech, Inc. to estimate NPSM input parameters associated with fecal coliform buildup (loading rates) and washoff from land surfaces. In addition, the spreadsheet can be used to estimate direct sources of fecal coliform loading to water bodies from leaking septic systems and animals having access to streams. Information from the WCS and spreadsheet tools were used as initial input for variables in the NPSM model.

7.2 Model Set Up

The Oconee River basin was delineated into 302 subwatersheds in order to characterize relative fecal coliform bacteria contributions from significant contributing drainage areas. The delineated watersheds correspond to the 12 digit HUCs established by the State of Georgia and are shown in Figures 4 and 5. Watershed delineation was based on the Reach File 3 (Rf3) stream coverage and Digital Elevation Model (DEM) data. This discretization allows management and load reduction alternatives to be varied by subwatershed.

The impaired watersheds below Lake Oconee were modeled independently of the watersheds above the lake. Monitoring data obtained from USGS gage 02223000, located at the downstream dam of Lake Oconee, was used to estimate the flow and fecal coliform load discharging into the Oconee River. Lake Oconee is not included on the 303(d) list for impairment due to fecal coliform. The loading from the lake was based on monitored concentration and flow data. The loading was assumed to be constant between sampling dates.

An important factor influencing model results is the precipitation data contained in the meteorological data file used in the simulation. The pattern and intensity of rainfall affects the build-up and wash-off of fecal coliform bacteria from the land into the streams, as well as the dilution potential of the stream. Precipitation data from a weather station in close proximity to a watershed was used in the simulations and are presented in Appendix A.

7.3 Model Calibration

Calibration of the watershed model included both hydrology and water quality components. The hydrology calibration was performed first and involved adjustment of the model parameters used to represent the hydrologic cycle until acceptable agreement was achieved between simulated flows and historic stream flow data from a USGS stream gaging station in the watershed for the same period of time.

Model parameters adjusted include: evapotranspiration, infiltration, upper and lower zone storage, groundwater storage, recession, losses to the deep groundwater system, and interflow discharge. Details of hydrologic calibrations are presented in Appendix A. Calibrated models were then subjected to model validation to ensure that generated model streamflows for each of the impaired segments were acceptable.

The model was also calibrated for water quality. Appropriate model parameters were adjusted to obtain acceptable agreement between simulated instream fecal coliform concentrations and observed data collected at the sampling stations indicated in Table 3. Water quality calibrations for the 303(d) listed stream are presented in Appendix B.

8.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS), which takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{ WLAs} + \Sigma \text{ LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. 40 CFR §130.2 (i) states that TMDLs can be expressed in terms of mass per time (e.g. pounds per day), toxicity, or other appropriate measure. For fecal coliform bacteria, the TMDLs are expressed as counts per 30 days.

8.1 Critical Conditions

The critical condition for nonpoint source fecal coliform loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, fecal coliform bacteria builds up on the land surface, and is washed off by rainfall. The critical condition for point source loading occurs during periods of low stream flow when dilution is minimized. Both conditions are simulated in the water quality model.

A definitive time period was used to simulate a continuous 30-day geometric mean concentration to compare to the target. This time period contained a range of hydrological conditions that included both low and high stream flows from which critical conditions were identified and used to derive the TMDL values.

The simulated 30-day geometric mean concentrations for existing conditions are presented in Appendix C. From these figures, critical conditions can be determined. The 30-day critical period in the model is the period preceding the largest simulated violation of the geometric mean standard (EPA, 1991). During periods where the model predicted extremely low stream flows, the model often became unstable and exhibited extreme positive or negative spikes. These portions of the simulation were excluded from consideration of the critical period. Meeting water quality standards during this period ensures that water quality standards can be achieved throughout the reviewed time period. For the listed segments in the Oconee River basin, the critical period used in development of the TMDLs is given in Table 8.

8.2 Existing Conditions

The existing fecal coliform load for each of the 303(d) listed waterbodies in the Oconee River basin was determined in the following manner:

- The calibrated model, corresponding to the portion of the Oconee River basin that is upstream of the pour point of the listed waterbody segment was run for a time period that included the critical condition. This critical time period is provided for each listed segment in Table 8.

- The existing fecal coliform load for each listed segment is represented as the sum of the NPDES permitted fecal coliform load from all point discharges (at design limits), the daily discharge load of other modeled direct sources (e.g. other direct sources such as animal access to streams, illicit discharges of fecal coliform bacteria, failing septic systems, or leaking sewer collection lines), and the daily fecal coliform load indirectly going to surface waters from all land uses (e.g. surface runoff), over the 30 day critical period. The existing loading rates given in Table 8 considers a die-off and absorption by soil for fecal coliform applied to land (during accumulation and before transported to the stream), but does not consider fecal coliform decay (die-off) during transport to the stream. The existing in-stream fecal coliform concentration given in Table 8 includes in-stream decay of the fecal coliform.

Model results indicate that nonpoint sources related to agricultural and urban land uses have the greatest impact on the fecal coliform bacteria loading in the Oconee River basin. Direct inputs of fecal coliform bacteria from "other sources" (i.e., animal access to streams, illicit discharges of fecal coliform bacteria, failing septic systems, and leaking sewer collection lines) are also shown to increase bacteria loading in the watershed. Reductions in these loading rates reduce the in-stream fecal coliform bacteria levels. Non-point source loading rates and the in-stream geometric mean concentration representing existing conditions during the critical period are shown in Table 8.

In general, point source loads from NPDES facilities do not significantly contribute to the impairment of the listed stream segments since discharges from these facilities are required to be treated to levels corresponding to instream water quality criteria. Table 5 provides point source loads from NPDES facilities for existing conditions based on DMRs, and loads for TMDL conditions based on permitted facility flows and limits. As shown in this table, most facilities for which data is available have existing (i.e. based on DMR reporting) loads that are significantly lower than the maximum load at the permit limits.

8.3 Margin of Safety

There are two methods for incorporating a MOS in the analysis: a) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. Both an explicit and an implicit MOS were incorporated in these TMDLs. Implicit MOS include conservative modeling assumptions and a continuous simulation that incorporates a range of meteorological events. Conservative modeling assumptions used include: septic systems discharging directly into the streams; development of the TMDL using loads based on the design flow and fecal coliform permit limits of NPDES facilities; and all land areas considered to be connected directly to streams.

An explicit MOS was included in the TMDLs by reducing the load allocation by 10 percent. In several of the TMDLs, a MOS was also included in the instream concentration by reducing the maximum simulated geometric mean concentration for the critical period to levels below the target. For example, in the Middle Oconee River TMDLs, the simulated peak geometric mean concentration for the allocation scenario was reduced to about 160 counts/100mL, or 40 counts/100mL below the criteria of 200 counts/100mL. This represents a MOS of about 20 percent.

8.4 Determination of TMDL, WLA, and LA

The TMDL is the total amount of pollutant that can be assimilated by a water body while maintaining water quality standards. Fecal coliform bacteria TMDLs are expressed as counts per 30-day period since this is how the water quality standard is expressed. The TMDL, therefore, represents the maximum fecal coliform bacteria load that can be assimilated by a stream during the critical 30-day period while maintaining the fecal coliform bacteria water quality standard of 200 counts / 100 ml. As previously stated, the TMDL is calculated using the equation:

$$\text{TMDL} = \Sigma\ \text{WLAs} + \Sigma\ \text{LAs} + \text{MOS}$$

With MOS equal to10 percent of the LA value, the TMDL, ∑WLA, and ∑LA were determined according to the following procedure:

- The calibrated model, corresponding to the portion of the watershed that is upstream of the pour point of the listed waterbody segment was run for a time period that included the critical condition as specified in Table 8.

- Existing NPDES permitted facilities and any known future facility discharges were assumed to discharge at design flows and the fecal coliform permit limit of 200 counts/100 ml.

- Fecal coliform land loading variables and the magnitude of loading from sources modeled as "other direct sources" were adjusted within reasonable range of known values until the resulting fecal coliform concentration at the pour point of the listed water body segment was less than or equal to 180 counts/100ml. (i.e. the water quality standard of 200 counts/100ml minus 20 counts/100ml [i.e. a 10% explicit MOS]).

- The ∑WLA is the load associated with the daily discharge loads of all modeled NPDES permitted facilities summed over the 30-day critical period. The discharge load for each facility represents the design flow at a fecal coliform concentration of 200 counts/100 ml (permitted limit).

- The ∑LA is the daily fecal coliform load indirectly going to surface waters from all modeled land use areas as a result of buildup/washoff processes plus the daily discharge load sources modeled as "other direct sources" and the result summed over the 30-day critical period. The resultant load was reduced by 10 percent and represents the MOS.

The TMDLs, WLAs, and LAs for the listed water bodies are summarized in Table 9.

8.4.1 Waste Load Allocations

There are approximately 54 NPDES permitted facilities that discharge fecal coliform bacteria in the Oconee River basin. Future facilities located on 303(d) listed waters should discharge wastewater at concentrations that do not cause or contribute to water quality impairment of these streams.

8.4.2 Load Allocations

There are two modes of transport for non-point source fecal coliform bacteria loading in the model. First, loading from failing septic systems, animals in the stream, and leaking sewer system collection lines are modeled as "other direct sources" to the stream and are independent of precipitation. The second mode involves loading resulting from fecal coliform accumulation on land surfaces and wash-off during storm events. Fecal coliform applied to land is subject to a die-off rate and an absorption rate before it is transported to the stream.

Model results were analyzed to determine which sources of fecal coliform have the greatest impact on the fecal coliform bacteria loadings in the Oconee River Basin. In general, nonpoint source runoff contributes the greatest fecal coliform load to the streams. Reductions in both urban and agricultural loads to the stream as well as reductions in direct sources to the stream (i.e., animal access to streams and leaking septic systems) are shown to improve water quality conditions. The percent reductions required from nonpoint source loads to the impaired streams are shown in Table 9.

Best management practices (BMPs) that could be used to implement this TMDL include controlling pollution from agriculture and urban runoff, identification and elimination of illicit discharges and other unknown "direct sources" of fecal coliform bacteria to the streams, and repair of leaking sewer collection lines and failing septic systems. Loading from agricultural sources may be minimized by adoption of NRCS resource management practices. NRCS practices include measures such as covering manure stacks exposed to the environment; reducing animal access to streams; and applying manure to croplands (if applicable) at agronomic rates. Measures which can reduce urban contributions include: repair and renovation of leaking sewer collection systems; reduction of sewer overflows and surcharges by use of separate conduit systems for domestic wastewater and stormwater; encouragement of households and businesses to connect to public sewer systems and reduce the population using septic systems.

Additional monitoring and characterization of the watershed should be conducted to verify the various other direct sources of fecal coliform bacteria in the watershed.

8.4.3 Seasonal Variation

Seasonal variation was incorporated in the continuous simulation water quality model by using varying monthly loading rates and daily meteorological data.

9.0 RECOMMENDATIONS

The TMDL analysis was performed using the best data available to specify WLAs and LAs that will meet the water quality criteria for fecal coliform in the Oconee River basin so as to support the use classification specified for each of the listed segments in Table 2. The following recommendations and strategies are targeted toward source identification, collection of data to support additional modeling and evaluation, and subsequent reduction in sources that are causing impairment of water quality.

9.1 Point Source Facilities

All discharges from point source facilities are required to be in compliance with the conditions of their NPDES permit at all times. All future facilities with the potential to discharge fecal coliform should be given limits that do not cause or contribute to water quality impairment.

9.2 Urban Sources of Fecal Coliform Loading

Urban sources of fecal coliform can best be addressed using a strategy which involves public participation and intergovernmental coordination to reduce the discharge of pollutants to the maximum extent practicable using management practices, control techniques, public education, and other appropriate methods and provisions. The following activities and programs conducted by cities, counties, and state agencies are recommended:

- Monitoring programs to identify the types and extent of fecal coliform water quality problems, relative degradation or improvement over time, areas of concern, and source identification;

- Requirements that all new and replacement sanitary sewage systems are designed to minimize discharges from the system into storm sewer systems;

- Mechanisms for reporting and correcting illicit connections, breaks, surcharges, and general sanitary sewer system problems;

- Sustained compliance with NPDES permit discharge requirements.

9.3 Agricultural Sources of Fecal Coliform Loading

The Georgia Environmental Protection Division (EPD) should coordinate with the Georgia Soil and Water Conservation Commission, and the Natural Resources Conservation Service (NRCS) to address issues concerning fecal coliform loading from agricultural lands in the Oconee River basin. It is recommended that information (such as livestock populations by subwatershed, animal access to streams, manure application practices, etc.) be evaluated periodically so that watershed models can be updated to reflect current conditions. It is further recommended that BMPs be utilized to reduce the amount of fecal coliform bacteria transported to surface waters from agricultural sources to the maximum extent practicable.

9.4 Stream Monitoring

Further monitoring of the fecal coliform concentrations at current and additional water quality monitoring stations in the watershed is needed to characterize sources of fecal coliform bacteria and document future reduction of loading. Georgia's watershed management approach specifies a five-year cycle for planning and assessment. Watersheds will be examined (or re-examined) as appropriate, on a rotating basis.

9.5 Future Efforts

This TMDL represents the first phase of a long-term process to reduce fecal coliform loading to meet water quality standards in the Oconee River basin. Implementation strategies will be reviewed and the TMDLs will be refined as necessary in the next phase (next five-year cycle). The phased approach will support progress toward water quality standards attainment in the future. In accordance with EPA TMDL guidance, these TMDLs may be revised based on results of future monitoring and source characterization data efforts.

10.0 Public Participation

A sixty-day public comment period was provided for this TMDL document. During the comment period, the availability of the TMDLs was public noticed, the TMDLs were posted on EPA's website, and copy of the TMDLs were provided, as requested, to the public for their comments. The response to comments received on the TMDLs can be found in the document entitled "*Responsiveness Summary Concerning EPA's August 30, 2001 Pubic Notice Proposing Fecal Coliform TMDLs For Waters in the State of Georgia*" (EPA, 2002).

11.0 Implementation

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of best management practices and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs) or other EPD contractors (hereinafter, "EPD Contractors") will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table" shown in Table 10 identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. See 40 C.F.R. § 122.44(d)(1)(vii)(B). NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

2. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA's "Best Management Practices Handbook", the "NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled "Watershed Wisdom -- Georgia's TMDL Program" will be distributed by EPD to the EPD Contractor for use with appropriate stakeholders for this TMDL, and a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

4. If for any reason an EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s)

completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan is the end of August 2003.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:
   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

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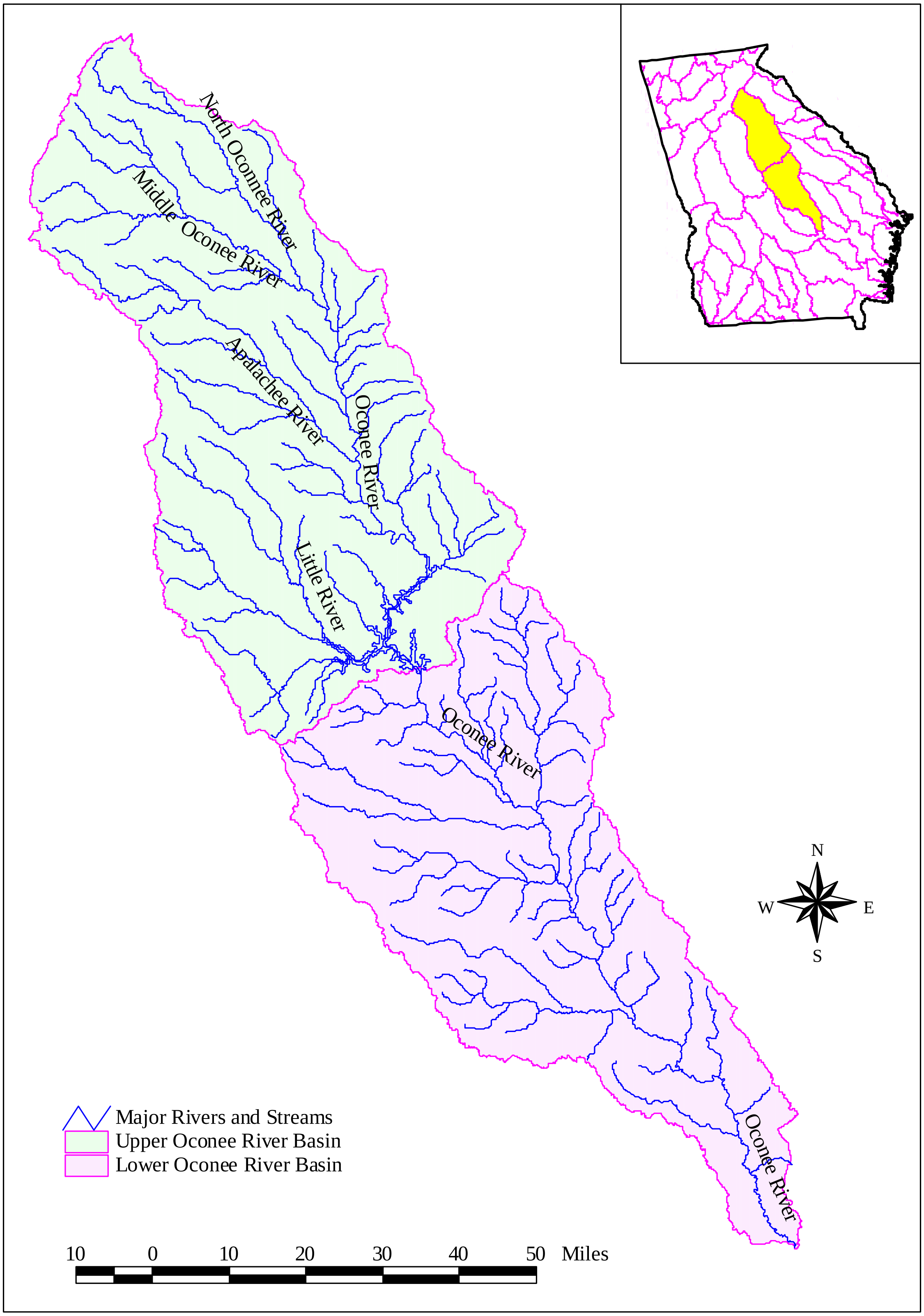


Figure 1. Oconee River Basin.

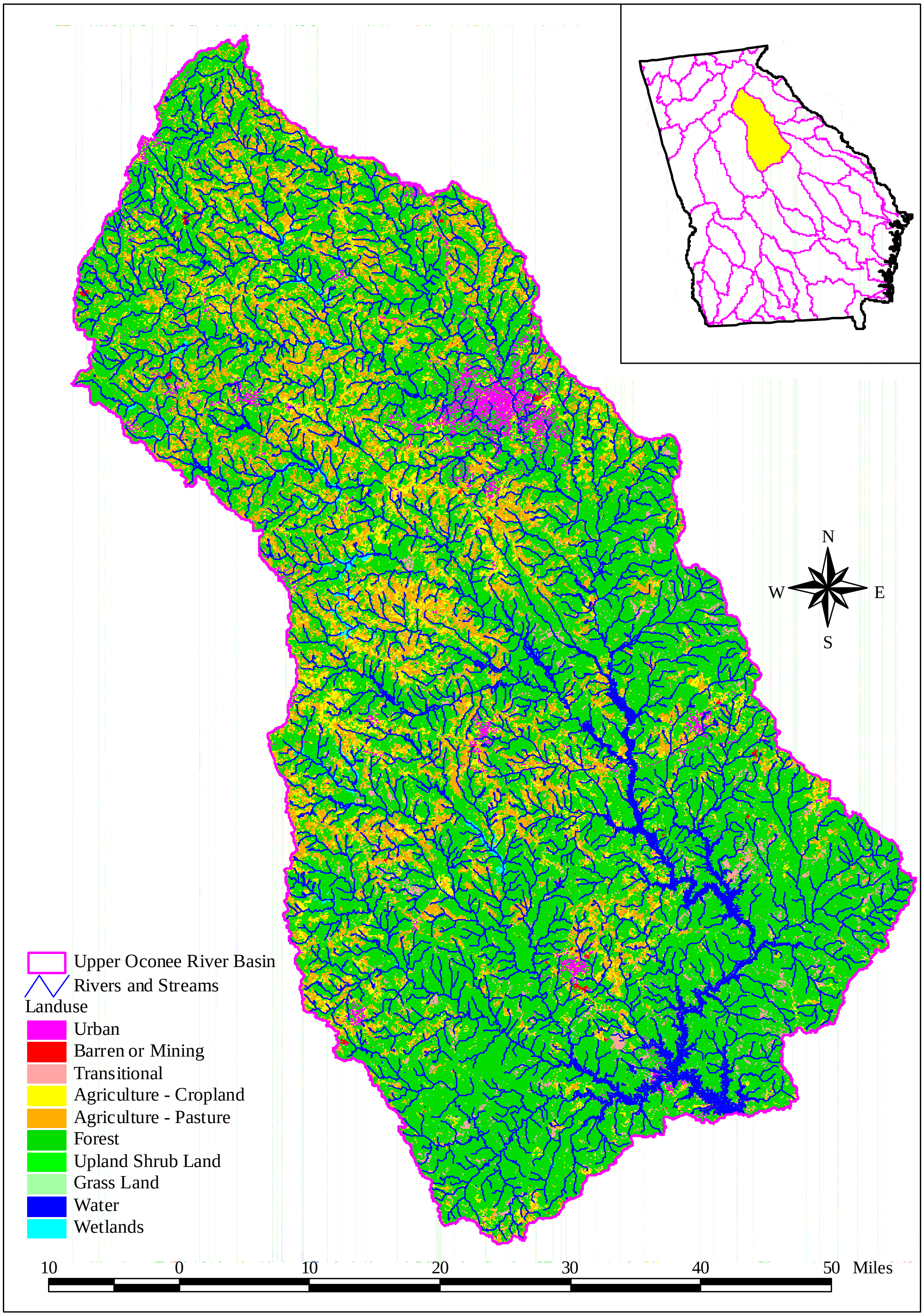


Figure 2. Landuse Distribution, Upper Oconee River Basin.

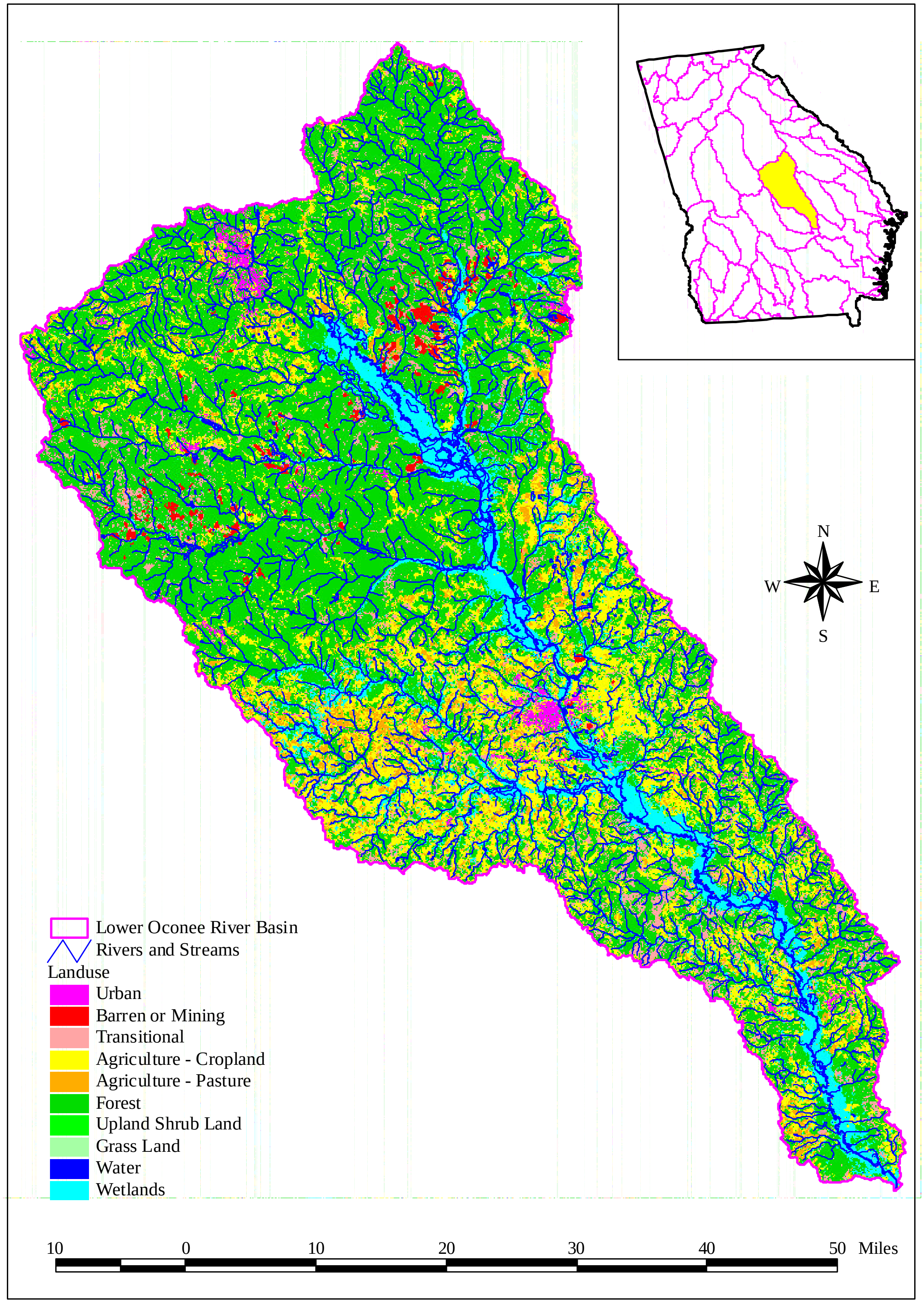


Figure 3. Landuse Distribution, Lower Oconee River Basin.

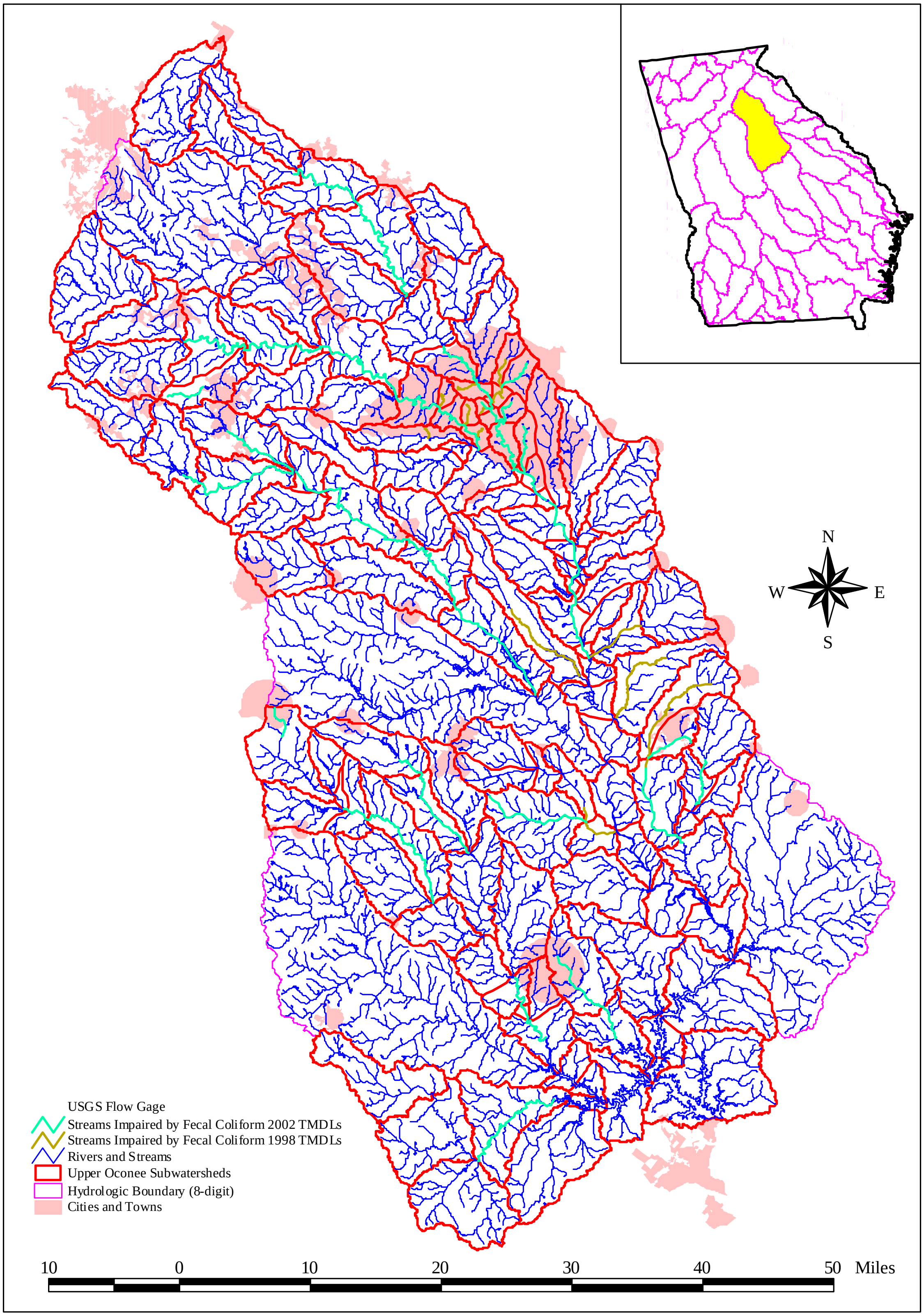


Figure 4. Subwatersheds and 303(d) Listed Streams, Upper Oconee River Basin.

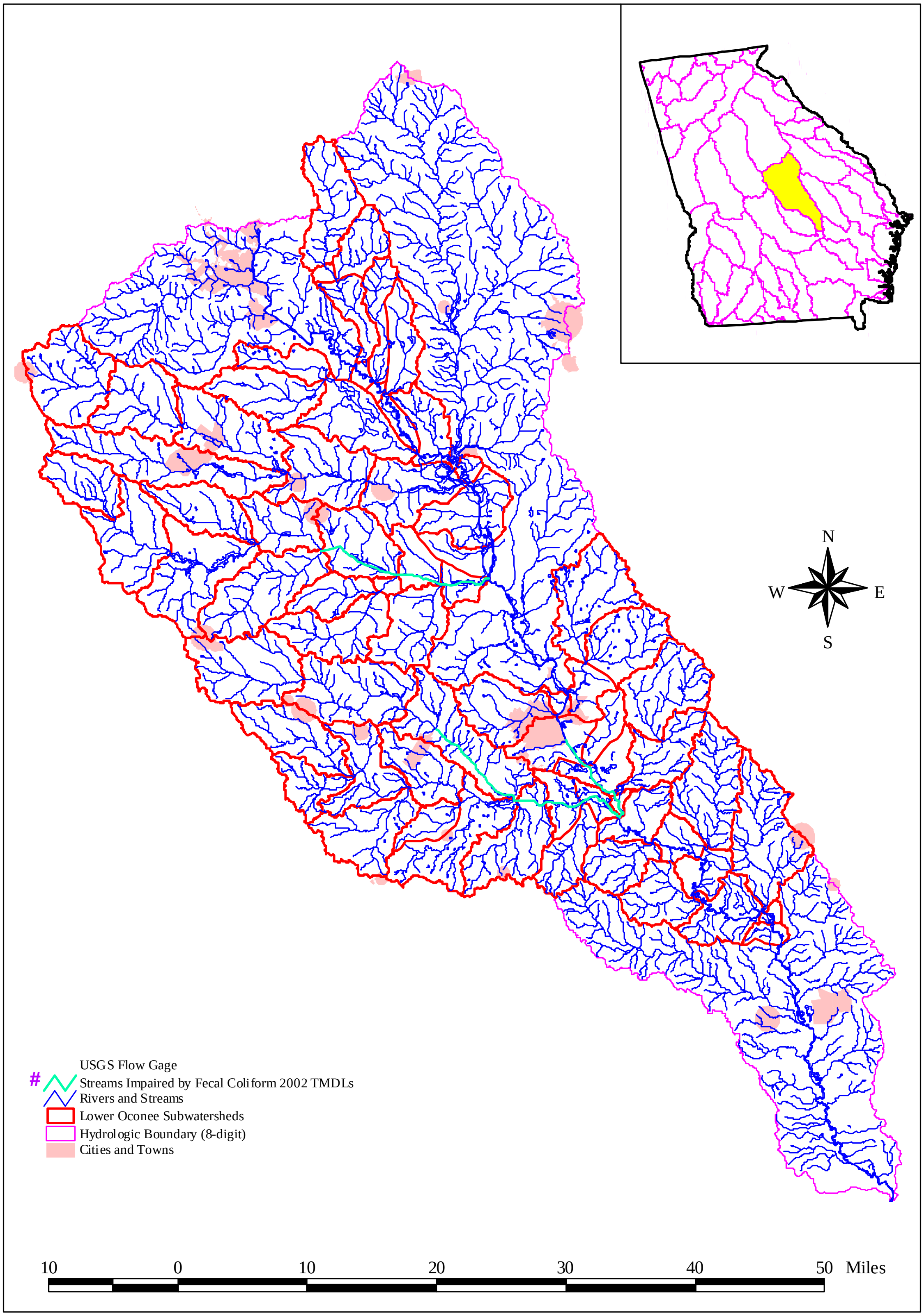


Figure 5. Subwatersheds and 303(d) Listed Streams, Lower Oconee River Basin.

Table 2 Land Use Distribution for Oconee River Watershed (Source: MRLC, 1993)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
Apalachee River (Marburg Creek to Lake Oconee)	72 (0.0)	57039 (32.3)	61 (0.0)	31478 (17.8)	866 (0.5)	0 (0.0)	160 (0.1)	1048 (0.6)	24779 (14.0)	913 (0.5)	981 (0.6)	37949 (21.5)	6 (0.0)	14575 (8.2)	2646 (1.5)	4272 (2.4)	0 (0.0)
Apalachee River (Williamson Creek to Marburg Creek)	0 (0.0)	17756 (40.0)	14 (0.0)	5597 (12.6)	213 (0.5)	0 (0.0)	22 (0.0)	262 (0.6)	6519 (14.7)	85 (0.2)	138 (0.3)	10234 (23.1)	0 (0.0)	1667 (3.8)	265 (0.6)	1630 (3.7)	0 (0.0)
Beaverdam Creek (Oliver Creek to Lake Oconee)	16 (0.1)	5408 (29.0)	2 (0.0)	6755 (36.2)	210 (1.1)	0 (0.0)	1 (0.0)	112 (0.6)	2253 (12.1)	133 (0.7)	85 (0.5)	1366 (7.3)	112 (0.6)	1664 (8.9)	469 (2.5)	79 (0.4)	0 (0.0)
Big Cedar Creek (Hog Creek to Lake Sinclair)	48 (0.1)	35501 (40.0)	29 (0.0)	32079 (36.2)	33 (0.0)	0 (0.0)	6 (0.0)	139 (0.2)	10185 (11.5)	505 (0.6)	46 (0.1)	3433 (3.9)	121 (0.1)	3082 (3.5)	3315 (3.7)	215 (0.2)	0 (0.0)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
Big Indian Creek (I-20 to Little Indian Creek)	31 (0.1)	6885 (27.6)	15 (0.1)	5474 (21.9)	95 (0.4)	0 (0.0)	0 (0.0)	206 (0.8)	3131 (12.6)	133 (0.5)	140 (0.6)	5091 (20.4)	0 (0.0)	2467 (9.9)	590 (2.4)	683 (2.7)	0 (0.0)
Big Sandy Creek (Porter Creek to Oconee River)	262 (0.1)	74175 (37.9)	93 (0.0)	50610 (25.9)	143 (0.1)	0 (0.0)	73 (0.0)	428 (0.2)	34460 (17.6)	1083 (0.6)	13 (0.0)	2302 (1.2)	4346 (2.2)	10118 (5.2)	13424 (6.9)	4177 (2.1)	0 (0.0)
Carr Creek (Headwaters to North Oconee River)	11 (0.5)	281 (13.0)	1 (0.0)	295 (13.7)	192 (8.9)	0 (0.0)	145 (6.7)	561 (26.0)	143 (6.6)	17 (0.8)	258 (11.9)	30 (1.4)	152 (7.0)	64 (3.0)	0 (0.0)	11 (0.5)	0 (0.0)
Cedar Creek (Headwaters to Oconee River)	3 (0.1)	842 (25.4)	0 (0.0)	643 (19.4)	64 (1.9)	0 (0.0)	204 (6.1)	883 (26.6)	438 (13.2)	7 (0.2)	46 (1.4)	107 (3.2)	0 (0.0)	77 (2.3)	0 (0.0)	7 (0.2)	0 (0.0)
Cedar Creek (Headwaters to Winder Reservoir)	2 (0.0)	3194 (35.9)	1 (0.0)	1121 (12.6)	263 (3.0)	0 (0.0)	74 (0.8)	261 (2.9)	1364 (15.3)	33 (0.4)	181 (2.0)	1823 (20.5)	0 (0.0)	522 (5.9)	38 (0.4)	9 (0.1)	0 (0.0)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
East Fork Trail Creek (Headwaters to West Fork Trail Creek)	11 (0.3)	643 (16.2)	1 (0.0)	925 (23.4)	239 (6.0)	0 (0.0)	13 (0.3)	321 (8.1)	484 (12.2)	25 (0.6)	79 (2.0)	723 (18.3)	0 (0.0)	474 (12.0)	0 (0.0)	21 (0.5)	0 (0.0)
Little River (Glady Creek to Lake Sinclair)	21 (0.0)	17502 (30.3)	35 (0.1)	11328 (19.6)	189 (0.3)	0 (0.0)	6 (0.0)	101 (0.2)	8052 (13.9)	290 (0.5)	287 (0.5)	11541 (20.0)	1 (0.0)	5728 (9.9)	1198 (2.1)	1505 (2.6)	0 (0.0)
Little River (Shoal Creek to Gap Creek)	143 (0.1)	59233 (31.0)	751 (0.4)	50846 (26.6)	677 (0.4)	0 (0.0)	85 (0.0)	1018 (0.5)	23931 (12.5)	1078 (0.6)	623 (0.3)	30132 (15.8)	248 (0.1)	14124 (7.4)	5369 (2.8)	2602 (1.4)	0 (0.0)
Little River (Social Circle to Nelson Creek)	1 (0.0)	5538 (31.9)	11 (0.1)	3131 (18.0)	118 (0.7)	0 (0.0)	5 (0.0)	53 (0.3)	2879 (16.6)	39 (0.2)	216 (1.2)	2953 (17.0)	0 (0.0)	1645 (9.5)	157 (0.9)	612 (3.5)	0 (0.0)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
Little Sugar Creek (Headwaters to Lake Oconee)	23 (0.1)	6191 (29.1)	6 (0.0)	5681 (26.7)	1 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2381 (11.2)	234 (1.1)	0 (0.0)	4377 (20.5)	0 (0.0)	1928 (9.1)	414 (1.9)	64 (0.3)	0 (0.0)
Marburg Creek (Masseys Lake to Apalachee River)	2 (0.0)	5216 (31.5)	6 (0.0)	2306 (13.9)	286 (1.7)	0 (0.0)	46 (0.3)	109 (0.7)	2351 (14.2)	335 (2.0)	166 (1.0)	4433 (26.8)	0 (0.0)	1134 (6.8)	2 (0.0)	167 (1.0)	0 (0.0)
Middle Oconee River (Headwaters to McNutt Creek)	16 (0.1)	11586 (41.4)	10 (0.0)	3708 (13.2)	294 (1.0)	0 (0.0)	256 (0.9)	1484 (5.3)	3837 (13.7)	114 (0.4)	182 (0.6)	4658 (16.6)	91 (0.3)	1008 (3.6)	223 (0.8)	529 (1.9)	0 (0.0)
Mulberry River (Little Mulberry River to Middle Oconee)	4 (0.0)	46273 (46.1)	38 (0.0)	7123 (7.1)	622 (0.6)	0 (0.0)	141 (0.1)	630 (0.6)	14292 (14.2)	365 (0.4)	469 (0.5)	21938 (21.9)	324 (0.3)	6581 (6.6)	529 (0.5)	1042 (1.0)	0 (0.0)
North Oconee River (Headwaters to Oconee River)	133 (0.1)	71895 (37.3)	50 (0.0)	26958 (14.0)	3337 (1.7)	0 (0.0)	1162 (0.6)	5413 (2.8)	27164 (14.1)	844 (0.4)	1540 (0.8)	38887 (20.2)	369 (0.2)	14136 (7.3)	43 (0.0)	914 (0.5)	0 (0.0)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
Oconee River (Headwaters to Lake Oconee)	447 (0.1)	132167 (32.7)	143 (0.4)	90775 (22.5)	4461 (0.1)	0 (0.0)	1502 (0.4)	8274 (2.0)	49332 (3.6)	14495 (3.6)	2801 (0.7)	62329 (15.4)	674 (0.2)	26619 (6.6)	7175 (1.8)	2598 (0.6)	0 (0.0)
Richland Creek (Interstate 20 to Beaverdam Creek)	50 (0.1)	10032 (29.6)	12 (0.0)	12103 (35.7)	277 (0.8)	0 (0.0)	58 (0.2)	664 (2.0)	3485 (10.3)	677 (2.0)	294 (0.9)	2891 (8.5)	47 (0.1)	2296 (6.8)	902 (2.7)	122 (0.4)	0 (0.0)
Rooty Creek (Rd. S926 Eatonton to Little Creek)	44 (0.2)	6990 (23.9)	11 (0.0)	8392 (28.7)	163 (0.6)	0 (0.0)	59 (0.2)	642 (2.2)	2771 (9.5)	937 (3.2)	113 (0.4)	4515 (15.4)	187 (0.6)	2501 (8.5)	1800 (6.2)	146 (0.5)	0 (0.0)
Tanyard Creek (U/s North Oconee River)	0 (0.0)	83 (11.4)	0 (0.0)	0 (0.0)	344 (47.5)	0 (0.0)	0 (0.0)	287 (39.7)	0 (0.0)	0 (0.0)	0 (0.0)	6 (0.8)	0 (0.0)	5 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)
Town Creek (Hwy. 15 to Richland Creek)	20 (0.3)	1182 (20.2)	0 (0.0)	1269 (21.6)	249 (4.2)	0 (0.0)	56 (0.9)	608 (10.4)	692 (11.8)	40 (0.7)	146 (2.5)	836 (14.3)	3 (0.0)	591 (10.1)	156 (2.7)	22 (0.4)	0 (0.0)

Stream/Segment	Land Use Categories - in units of acres (percent)																
	Bare Rock/Sand/Clay	Deciduous Forest	Emergent Herbaceous Wetlands	Evergreen Forest	High Intensity Commercial/Industrial/Transportation	Low Intensity Commercial/Industrial/Transportation	High Intensity Residential	Low Intensity Residential	Mixed Forest	Open Water	Other Grasses Urban/Recreational	Pasture/Hay	Quarries/Strip Mines/Gravel Pits	Row Crops	Transitional	Woody Wetlands	Unclassified
Turkey Creek (Horse Branch to Rocky Creek)	75 (0.1)	19037 (24.10	13 (0.0)	11398 (14.4)	347 (0.4)	0 (0.0)	53 (0.1)	468 (0.6)	9776 (12.4)	257 (0.3)	485 (0.6)	5536 (7.0)	18 (0.0)	17766 (22.5)	3523 (4.5)	10166 (12.9)	0 (0.0)
Turkey Creek (Rocky Creek to Oconee River)	215 (0.1)	36642 (16.0)	132 (0.1)	30832 (13.4)	1048 (0.5)	0 (0.0)	73 (0.0)	779 (0.3)	19311 (8.4)	807 (0.4)	825 (0.4)	24484 (10.7)	25 (0.0)	71175 (31.0)	13600 (5.9)	29618 (12.9)	0 (0.0)

Table 3 Waterbodies Listed for Fecal Coliform Bacteria in the Oconee River Basin (Source: EPD)

Stream Name	Segment Description	Segment Length (miles)	Designated Use Classification	Partially Supporting Designated Uses	Not Supporting Designated Uses
Apalachee River	Marburg Creek to Lake Oconee	35	Fishing	X	
Apalachee River	Williamson Cr to Marburg Cr	7	Fishing		X
Beaverdam Creek	Oliver Creek to Lake Oconee	4	Fishing		X
Big Cedar Creek	Hog Creek to Lake Sinclair	11	Fishing	X	
Big Indian Creek	I-20 to Little Indian Creek	11	Fishing	X	
Big Sandy Creek	Porter Creek to Oconee River	14	Fishing		X
Carr Creek	Headwaters to North Oconee River	2	Fishing	X	
Cedar Creek	Headwaters to Oconee River	4	Fishing		X
Cedar Creek	Headwaters to Winder Reservoir	4	Fishing		X
East Fork Trail Creek	Headwaters to West Fork Trail Creek	3	Fishing	X	
Little River	Glady Creek to Lake Sinclair	8	Fishing	X	
Little River	Shoal Creek to Gap Creek	14	Fishing		X
Little River	Social Circle to Nelson Creek	3	Fishing		X
Little Sugar Creek	Headwaters to Lake Oconee	9	Fishing		X
Marburg Creek	Masseys Lake to Apalachee River	7	Fishing		X
Middle Oconee River	Big Bear Creek to McNutt Creek	12	Fishing	X	
Middle Oconee River	Mulberry River to Big Bear Creek	11	Fishing		X
Mulberry River	Little Mulberry River to Middle Oconee	18	Fishing	X	
North Oconee River	Bordens Creek to Curry Creek	8	Fishing		X
North Oconee River	Chandler Creek to Bordens Creek	12	Fishing		X

Stream Name	Segment Description	Segment Length (miles)	Designated Use Classification	Partially Supporting Designated Uses	Not Supporting Designated Uses
North Oconee River	Jackson County to Sandy Creek	5	Fishing/ Drinking Water	X	
North Oconee River	Sandy Creek to Trail Creek	2	Fishing/ Drinking Water		X
North Oconee River	Trail Creek to Oconee River	8	Fishing	X	
Oconee River	Barnett Shoals to Lake Oconee	16	Fishing	X	
Oconee River	Confluence of North & Middle Oconee Rivers	4	Fishing		X
Oconee River	Long Branch to Turkey Creek	9	Fishing	X	
Richland Creek	Interstate 20 to Beaverdam Creek	8	Fishing		X
Rooty Creek	Rd. S926 Eatonton to Little Creek	9	Fishing		X
Tanyard Creek	U/s North Oconee River	1	Fishing		X
Town Creek	Hwy. 15 to Richland Creek	4	Fishing		X
Turkey Creek	Horse Branch to Rocky Creek	10	Fishing		X
Turkey Creek	Rocky Creek to Oconee River	11	Fishing	X	

Table 4 1999 Water Quality Monitoring Stations (Source: EPD)

Stream Name	Segment Description	USGS Monitoring Station No.	Monitoring Station Description
Apalachee River	Marburg Creek to Lake Oconee	02219000 02219148	Apalachee River near Boswick, Georgia and Apalachee River at State Road 24 near Apalachee, Georgia
Apalachee River	Williamson Creek to Marburg Creek	02218700	Apalachee River at State Road 11 near Bethlehem, Georgia
Beaverdam Creek	Oliver creek to Lake Oconee	02220395	Beaverdam Creek at Walkers Church Road (County Road 66) near Veazey, Georgia
Big Cedar Creek	Hog Creek to Lake Sinclair	02221900	Big Cedar Creek at U.S. Hwy 129 near Eatonton, Georgia
Big Indian Creek	I-20 to Little Indian Creek	02220850	Big Indian Creek at Georgia Hwy 83 near Madison, Georgia
Big Sandy Creek	Porter Creek to Oconee River	02223368	Big Sandy Creek at State Road 112 near Toomsboro, Georgia
Carr Creek	Headwaters to North Oconee River	02217915	Carr Creek at Bailey Street near Athens, Georgia
Cedar Creek	Headwaters to Oconee River	02217996	Cedar Creek at Barnett Shoals Drive near Athens, Georgia
Cedar Creek	Headwaters to Winder Reservoir	02217299	Cedar Creek at State Road 211 near Winder, Georgia
East Fork Trail Creek	Headwaters to West Fork Trail Creek	02217866	East Fork Trail Creek Tributary (Carver Branch) at Olympic Drive near Athens, Georgia
Little River	Glady Creek to Lake Sinclair	02220900	Little River at State Road 16 near Eatonton, Georgia
Little River	Shoal Creek to Gap Creek	02220800	Little River at Georgia Hwy 83 near Godfrey, Georgia
Little River	Social Circle to Nelson Creek	02220783	Little River at U.S. Hwy 278 near Covington, Georgia
Little Sugar Creek	Headwaters to Lake Oconee	02220100	Little Sugar Creek at Kingston Road (County Road 127) near Buckhead, Georgia
Marburg Creek	Masseys Lake to Apalachee River	02218805	Marburg Creek at Manning Gin Road near Bethlehem, Georgia
Middle Oconee River	Big Bear Creek to McNutt Creek	02217515	Middle Oconee River at U.S. Hwy 441 near Athens, Georgia
Middle Oconee River	Mulberry River to Big Bear Creek	02217475	Middle Oconee River at Georgia Hwy 82 near Arcade, Georgia

Stream Name	Segment Description	USGS Monitoring Station No.	Monitoring Station Description
Mulberry River	Little Mulberry River to Middle Oconee	02217380	Mulberry River at Georgia Hwy 11 near Winder, Georgia
North Oconee River	Bordens Creek to Curry Creek	02217646	North Oconee River at State Hwy 335 near Nicholson, Georgia
North Oconee River	Chandler Creek to Bordens Creek	02217610	North Oconee River at Georgia Hwy 82 near Maysville, Georgia
North Oconee River	Jackson County to Sandy Creek	02217740	North Oconee River – Athens Water Intake
North Oconee River	Sandy Creek to Trail Creek	No station	No station
North Oconee River	Trail Creek to Oconee River	02217950	North Oconee River at Whitehall Road near Whitehall, Georgia
Oconee River	Barnett Shoals to Lake Oconee	02218300	Oconee River at Georgia Hwy 15 near Penfield, Georgia
Oconee River	Confluence of North & Middle Oconee Rivers	02218000	Oconee River at Barnett Shoals Road near Athens, Georgia
Oconee River	Long Branch to Turkey Creek	02223600	Oconee River at U.S. Hwy 80 near Dublin, Georgia
Richland Creek	Interstate 20 to Beaverdam Creek	03038751*	Richland Creek at Interstate 20 near Greensboro, Georgia
Rooty Creek	Rd. S926 Eatonton to Little Creek	02220735	Rooty Creek at Martin Luther King Jr. Drive (County Road 90) near Eatonton, Georgia
Tanyard Creek	U/S North Oconee River	02217906	Tanyard Creek at East Campus Drive near Athens, Georgia
Town Creek	Hwy. 15 to Richland Creek	02220368	Town Creek at Old Covington Road (County Road 39) near Greensboro, Georgia
Turkey Creek	Horse Branch to Rocky Creek	02223940	Turkey Creek at Walker Dairy Road (County Road 338) near Dudley, Georgia
Turkey Creek	Rocky Creek to Oconee River	02224100	Turkey Creek at U.S. Hwy 441 near Dublin, Georgia

* Georgia monitoring station number; no corresponding USGS station

Table 5 Water Quality Monitoring Data (Source: EPD)

Stream/Segment	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)
Apalachee River (Marburg Creek to Lake Oconee)	01/05/1999	4900	795	05/26/1999	80	299	07/28/1999	170	158	11/28/1999	490	255
	01/19/1999	20		06/09/1999	80		08/11/1999	220		12/13/1999	220	
	01/25/1999	1700		06/15/1999	5400		08/18/1999	330		12/15/1999	790	
	02/02/1999	2400		06/21/1999	230		08/25/1999	50		12/20/1999	50	
Apalachee River (Williamson Creek to Marburg Creek)	01/19/1999	230	469	05/26/1999	330	501	07/28/1999	1100	255	11/29/1999	230	367
	01/25/1999	1300		06/09/1999	1800		08/11/1999	130		12/13/1999	490	
	02/02/1999	490		06/15/1999	230		08/18/1999	60		12/15/1999	490	
	02/03/1999	330		06/21/1999	460		08/25/1999	490		12/20/1999	330	
Beaverdam Creek (Oliver creek to Lake Oconee)	01/06/1999	490	490	05/25/1999	490	732	07/27/1999	130	436	11/09/1/99	130	190
	01/20/1999	460		06/14/1999	130		08/10/1999	1100		11/16/1999	110	
	01/26/1999	490		06/16/1999	9200		08/17/1999	110		11/23/1999	130	
	02/03/1999	490		06/22/1999	490		08/24/1999	2300		12/07/1999	700	
Big Cedar Creek (Hog Creek to Lake Sinclair)	01/26/1999	790	184	05/11/1999	110	113	08/17/1999	80	243	11/16/1999	310	208
	02/09/1999	130		05/18/1999	80		08/24/1999	700		11/30/1999	120	
	02/16/1999	140		06/01/1999	80		08/31/1999	230		12/07/1999	230	
	02/23/1999	80		06/08/1999	230		09/14/1999	270		12/14/1999	210	
Big Indian Creek (I-20 to Little Indian Creek)	01/05/1999	9200	1765	05/26/1999	80	123	07/28/1999	130	170	11/29/1999	20	52
	01/19/1999	20		06/09/1999	220		08/11/1999	490		12/13/1999	20	
	01/25/1999	24000		06/15/1999	330		08/18/1999	50		12/15/1999	230	
	02/02/1999	2200		06/21/1999	40		08/25/1999	330		12/20/1999	80	
Big Sandy Creek (Porter Creek to Oconee River)	01/27/1999	230	228	05/12/1999	1100	247	08/18/1999	490	319	11/17/1999	130	91
	02/10/1999	140		05/19/1999	220		08/25/1999	490		12/01/1999	80	
	02/17/1999	490		06/02/1999	170		09/01/1999	130		12/08/1999	50	
	02/24/1999	170		06/09/1999	90		09/15/1999	330		12/15/1999	130	
	07/14/1999	760										
Carr Creek (Headwaters to North Oconee River)	11/23/1999	<20	55	03/15/1999	<20		05/18/1999	130		08/10/1999	20	
	12/01/1999	330		04/01/1999	2300		06/15/1999	20		09/27/1999	2200	
	12/16/1999	70		04/05/1999	20		07/20/1999	170		10/13/1999	17000	
	12/20/1999	20										
Cedar Creek (Headwaters to Oconee River)	03/30/1999	130	215	05/03/1999	330	961	09/07/1999	230	1322	11/01/1999	130	198
	03/31/1999	1400		05/06/1999	16000		09/08/1999	790		11/09/1999	170	
	04/05/1999	90		05/19/1999	490		09/21/1999	700		11/22/1999	3500	
	04/22/1999	130		05/26/1999	330		10/04/1999	>24000		11/29/1999	<20	
Cedar Creek (Headwaters to Winder Reservoir)	02/15/1999	460	264	05/27/1999	330	723	07/29/1999	330	446	11/30/1999	140	316
	02/21/1999	40		06/10/1999	1300		08/12/1999	1100		12/14/1999	1800	
	02/28/1999	110		06/17/1999	1300		08/19/1999	330		12/16/1999	790	
	03/03/1999	2400		06/22/1999	490		08/26/1999	330		12/21/1999	50	
East Fork Trail Creek (Headwaters to West Fork Trail Creek)	03/15/1999	210	171	05/03/1999	490	171	09/07/1999	130	509	11/01/1999	20	51
	03/18/1999	80		05/06/1999	790		09/08/1999	140		11/09/1999	50	
	03/30/1999	630		05/16/1999	20		09/21/1999	230		11/22/1999	330	
	03/31/1999	80		05/26/1999	110		10/04/1999	16000		11/29/1999	<20	
	12/06/1999	460										
Little River (Glady Creek to Lake Sinclair)	01/07/1999	790	392	05/24/1999	80	170	08/10/1999	330	330	11/08/1999	140	136
	01/21/1999	70		06/07/1999	80		08/12/1999	330		11/15/1999	130	
	01/27/1999	330		06/14/1999	400		0816/1999	330		11/22/1999	170	
	02/04/1999	1300		06/21/1999	330		08/23/1999	330		12/06/1999	110	

Stream/Segment	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)
Little River (Shoal Creek to Gap Creek)	01/05/1999	790	1239	05/26/1999	230	706	07/28/1999	700	2815	11/29/1999	700	612
	01/19/1999	230		06/26/1999	1700		08/11/1999	1700		12/13/1999	170	
	01/25/1999	5400		06/15/1999	490		08/18/1999	2200		12/15/1999	2400	
	02/02/1999	2400		06/21/1999	1300		08/28/1999	24000		12/20/1999	490	
Little River (Social Circle to Nelson Creek)	01/05/1999	2200	1201	05/26/1999	3500	942	07/28/1999	1800	1650	11/29/1999	170	365
	01/16/1999	130		06/09/1999	700		08/11/1999	1100		12/13/1999	3500	
	01/25/1999	9200		06/15/1999	460		08/18/1999	2200		12/15/1999	270	
	02/02/1999	790		06/21/1999	700		08/25/1999	1700		12/20/1999	110	
Little Sugar Creek (Headwaters to Lake Oconee)	01/01/1999	790	1016	05/25/1999	790	1152	07/27/1999	460	229	11/09/1999	330	221
	01/20/1999	330		06/14/1999	490		08/24/1999	110		11/16/1999	130	
	02/03/1999	1700		06/16/1999	3500		08/25/1999	20		11/23/1999	70	
	03/22/1999	2400		06/22/1999	1300		09/25/1999	7900		12/06/1999	790	
Marburg Creek (Masseys Lake to Apalachee River)	01/05/1999	170	325	06/26/1999	130	336	07/28/1999	330	189	11/29/1999	790	2107
	01/19/1999	1100		0609/1999	270		08/11/1999	230		12/13/1999	24000	
	01/25/1999	260		06/15/1999	790		08/18/1999	130		12/15/1999	80	
	0202/1999	230		06/21/1999	460		08/25/1999	130		12/20/1999	13000	
Middle Oconee River (Big Bear Creek to McNutt Creek)	04/01/1999	330	116	05/18/1999	80	140	09/22/1999	330	775	12/01/1999	330	294
	04/05/1999	220		05/25/1999	460		09/27/1999	360		12/14/1999	790	
	04/22/1999	50		05/27/1999	80		10/05/1999	9200		12/16/1999	260	
	04/27/1999	50		06/17/1999	130		10/13/1999	330		12/20/1999	110	
	11/23/1999	110										
Middle Oconee River (Mulberry River to Big Bear Creek)	02/15/1999	2200	390	05/27/1999	130	407	07/29/1999	790	500	11/30/1999	310	398
	02/21/1999	230		06/10/1999	330		08/12/1999	330		12/14/1999	2800	
	02/28/1999	270		06/17/1999	4900		08/19/1999	490		12/16/1999	170	
		170		06/22/1999	130		08/26/1999	490		12/21/1999	170	
Mulberry River (Little Mulberry River to Middle Oconee)	02/15/1999	170	196	05/27/1999	1300	735	07/29/1999	20	147	11/30/1999	110	276
	02/21/1999	330		06/10/1999	170		08/12/1999	130		12/14/1999	490	
	02/28/1999	80		06/17/1999	4900		08/19/1999	790		12/16/1999	220	
	03/03/1999	330		06/22/1999	270		08/26/1999	230		12/21/1999	490	
North Oconee River (Bordens Creek to Curry Creek)	02/15/1999	170	175	05/27/1999	50	279	07/29/1999	220	257	11/30/1999	460	982
	02/21/199	330		06/10/1999	230		08/12/1999	130		12/14/1999	2200	
	02/28/1999	130		06/17/1999	3100		08/19/1999	460		12/16/1999	5400	
	03/03/1999	130		06/22/1999	170		08/26/1999	330		12/21/1999	170	
North Oconee River (Chandler Creek to Bordens Creek)	02/15/1999	460	551	05/27/1999	230	736	07/29/1999	230	272	11/30/1999	490	>1398
	02/21/1999	700		06/10/1999	330		08/12/1999	70		12/14/1999	>24000	
	02/28/1999	220		06/17/1999	7900		08/19/1999	310		12/16/1999	1300	
	03/03/1999	1300		06/22/1999	490		08/26/1999	1100		12/21/1999	250	
North Oconee River (Sandy Creek to Trail Creek)	04/01/1999	4100	416	05/18/1999	490	409	09/22/1999	790	739	12/01/1999	330	761
	04/05/1999	330		05/25/1999	330		09/27/1999	700		12/14/1999	630	
	04/22/1999	130		05/27/1999	220		10/05/1999	1100		12/16/1999	4900	
	04/27/1999	170		06/15/1999	790		10/13/1999	490		12/20/1999	330	
	07/20/1999	150		08/10/1999	460		11/23/1999	140				
North Oconee River (Trail Creek to Oconee River)	04/01/1999	5400	196	05/18/1999	50	98	09/22/1999	170	826	12/01/1999	130	301
	04/05/1999	170		05/25/1999	50		09/27/1999	7000		12/14/1999	2400	
	04/22/1999	20		05/27/1999	110		10/05/1999	1700		12/16/1999	330	
	04/27/1999	80		06/17/1999	340		10/13/1999	230		12/20/1999	80	
	11/23/1999	50										
Oconee River (Barnett Shoals to Lake Oconee)	01/06/1999	3100	571	05/25/1999	330	585	07/27/1999	130	166	11/09/1999	310	524
	01/20/1999	20		06/08/1999	220		08/10/1999	70		11/16/1999	310	
	01/26/1999	490		06/16/1999	7000		08/17/1999	170		11/23/1999	1700	
	02/03/1999	3500		06/22/1999	230		08/24/1999	490		12/07/1999	460	

Stream/Segment	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)	Sample Dates	Fecal Coliform Bacteria (MPN/100 ml.)	Geometric Mean (#/100 ml.)
Oconee River (Athens to Barnett Shoals Dam)	01/08/1999 01/14/1999 01/21/1999	1300 1300 40 340	389	05/18/1999 05/25/1999 05/27/1999 06/15/1999	170 460 50 1100	256	09/22/1999 09/27/1999 10/05/1999 10/13/1999	790 7000 3500 1700	2395	12/01/1999 12/14/1999 12/16/1999 12/20/1999	80 1100 790 270	370
	04/01/1999 04/27/1999	3300 220		07/20/1999	70		08/10/1999	4900		11/23/1999	50	
Oconee River (Long Branch to Turkey Creek)	01/28/1999 02/11/1999 02/18/1999 02/25/1999	50 1300 2400 <20	236	05/13/1999 05/20/1999 06/03/1999 06/10/1999	330 170 330 110	212	08/19/1999 08/26/1999 09/02/1999 09/16/1999	80 50 70 <20	49	11/18/1999 12/02/1999 12/09/1999 12/16/1999	40 170 50 170	87
Richland Creek (Interstate 20 to Beaverdam Creek)	01/06/1999 01/20/1999 01/26/1999 0203/1999	5400 130 5400 5400	2127	05/25/1999 06/14/1999 06/16/1999 06/22/1999	2200 5400 17000 460	3105	07/27/1999 0810/1999 08/17/1999 08/24/1999	1300 330 5400 1300	1317	11/09/1999 11/16/1999 11/23/1999 12/07/1999	490 490 1100 1300	765
Rooty Creek (Rd. S926 Eatonton to Little Creek)	01/07/1999 01/21/1999 01/27/1999 02/04/1999	3500 40 9200 24000	2358	5/24/1999 06/07/1999 06/14/1999 06/21/1999	130 80 9200 460	458	08/10/1999 08/12/1999 08/16/1999 08/23/1999	170 330 1700 790	524	11/08/1999 11/15/1999 11/22/1999 12/06/1999	220 230 330 330	390
Tanyard Creek (U/s North Oconee River)	03/15/1999 03/18/1999 03/30/1999 03/31/1999	20 230 170 3500	229	05/03/1999 05/06/1999 05/19/1999 05/26/1999	490 24000 16000 790	3492	09/07/1999 09/08/1999 09/21/1999 10/04/1999	25400 740 1400 3500	2104	11/01/1999 11/09/1999 11/22/1999 11/29/1999	330 330 330 20	164
Town Creek (Hwy. 15 to Richland Creek)	01/06/1999 01/20/1999 01/26/1999 02/03/1999	2400 490 1300 5400	1695	05/25/1999 06/14/1999 06/16/1999 06/22/1999	700 170 2200 3500	978	07/27/1999 08/10/1999 08/17/1999 08/24/1999	490 54000 330 2300	2117	11/09/1999 11/16/1999 11/23/1999 12/07/1999	50 70 790 9200	399
Turkey Creek (Horse Branch to Rocky Creek)	01/28/1999 02/11/1999 02/18/1999 02/25/1999	20 490 <20 170	76	05/13/1999 05/20/1999 06/03/1999 06/10/1999	80 490 460 330	278	08/19/1999 08/26/1999 09/02/1999 09/16/1999	1700 1200 330 790	854	11/18/1999 12/02/1999 12/09/1999 12/16/1999	170 460 220 700	331
Turkey Creek (Rocky Creek to Oconee River)	01/28/1999 02/11/1999 02/18/1999 02/25/1999	70 330 790 50	174	05/13/1999 05/20/1999 06/03/1999 06/10/1999	790 80 130 230	208	08/19/1999 08/26/1999 09/02/1999 09/16/1999	230 170 110 140	157	11/18/1999 12/02/1999 12/09/1999 12/16/1999	230 130 80 80	118

Table 6 NPDES Facilities Discharging Fecal Coliform in the Oconee River Basin

Facility Name	NPDES Permit No.	1999 Discharge Monitoring Reports		NPDES Permit Limits	
		Avg. Flow (MGD)	Avg. Fecal Coliform Loading[a] (counts/hr)	Avg. Flow (MGD)	Avg. Fecal Coliform Loading[b] (counts/hr)
Ailey WPCP	GA0049247	No data available		0.08	2.53E+07
Athens Cedar Cr	GA0034584	1.35	1.61E+07	2.00	6.32E+08
Athens Middle Oconee	GA0021733	3.95	6.07E+07	6.00	1.90E+09
Athens-North Oconee	GA0021725	8.70	1.24E+08	10.72	3.39E+09
Country Corners MHP	GA0023060	No data available		0.06	1.83E+07
Crawford Westside WPCP	GA0033707	No data available		0.04	1.17E+07
Dexter WPCP	GA0048682	No data available		0.08	2.37E+07
Dublin WPCP	GA0025569	2.72	3.59E+08	4.00	1.26E+09
Dudley WPCP	GA0023957	No data available		0.12	3.63E+07
East Hall High School	GA0034878	No data available		0.03	8.85E+06
E. Laurens Elem. School	GA0022691	No data available		0.03	1.07E+07
Eatonton East WPCP	GA0032271	0.27	1.37E+06	0.28	8.69E+07
Eatonton West WPCP	GA0032263	0.20	1.20E+06	0.39	1.23E+08
Forstmann Co.	GA0003760	1.45	0.00E+00	3.50	1.11E+09
GA College Lake Laurel	GA0031593	No data available		0.002	6.32E+05
Glenwood WPCP	GA0021377	No data available		0.11	3.48E+07
Gordon WPCP	GA0020397	No data available		0.75	2.37E+08
Greensboro North Pond	GA0021342	0.03	0.00E+00	0.10	3.16E+07
Greensboro South	GA0021351	0.35	4.32E+07	1.00	3.15E+08
H&H Mobile Home Village	GA0022438	No data available		0.01	2.84E+06
Hallmark Mobile Home	GA0030236	No data available		0.06	1.83E+07
Heartwood MHP	GA0049875	No data available		0.09	2.84E+07
Jackson County BD of Comm	GA0002712	No data available		0.10	3.16E+07
Jasper County BD of Comm	GA0034142	No data available		0.01	3.79E+06
Jefferson Pond	GA0023132	0.10	0.00E+00	0.29	9.16E+07
Jeffersonville WPCP	GA0020940	0.22	5.83E+07	0.25	7.90E+07
Madison Northside	GA0023159	No data available		0.14	4.42E+07
Madison Southside	GA0023141	No data available		0.66	2.09E+08
Maysville Pond	GA0032905	No data available		0.06	1.90E+07
Mid. GA Correction	GA0022110	No data available		0.03	9.48E+06
Milledgeville WPCP	GA0030775	4.47	7.49E+08	7.00	2.21E+09
Monroe Jacks Cr	GA0047171	1.11	3.73E+07	3.40	1.07E+09
Monticello Pearson	GA0020141	No data available		0.17	5.37E+07
Monticello White Oak	GA0020150	No data available		0.12	3.63E+07
Mt. Vernon WPCP	GA0033758	No data available		0.27	8.53E+07

Facility Name	NPDES Permit No.	1999 Discharge Monitoring Reports		NPDES Permit Limits	
		Avg. Flow (MGD)	Avg. Fecal Coliform Loading[a] (counts/hr)	Avg. Flow (MGD)	Avg. Fecal Coliform Loading[b] (counts/hr)
Oconee Co/Calls Cr	GA0050211	No data available		0.40	1.26E+08
Oconee Health Care Center	GA0035238	No data available		0.01	1.90E+06
Pinewood So. MHP	GA0034215	No data available		0.03	8.22E+06
Pinewood Estates	GA0034223	No data available		0.04	1.39E+07
Rock Eagle 4-H Center	GA0022233	No data available		0.16	4.90E+07
Rutledge Pond	GA0025895	No data available		0.05	1.58E+07
Sandersville WPCP	GA0032051	0.96	1.18E+07	1.70	5.37E+08
Social Circle	GA0026107	0.35	2.61E+07	0.45	1.42E+08
Soperton WPCP	GA0020826	No data available		0.40	1.26E+08
Southeast Paper MFG	GA0032620	15.91	No data	15.00	4.74E+09
Sparta Pond	GA0025593	No data available		0.08	2.53E+07
Statham WPCP	GA0020044	No data available		0.15	4.74E+07
W. Laurens High School	GA0022705	No data available		0.05	1.64E+07
White Sulfur Elem. School	GA0027120	No data available		0.00	4.11E+05
Wilkinson Co. High School	GA0031291	No data available		0.02	6.95E+06
Winder Barber Cr	GA0023205	0.03	0.00E+00	0.02	6.32E+06
Winder Marburg Cr	GA0023191	0.48	1.68E+07	0.60	1.90E+08
Woodland T. MHP	GA0033880	No data available		0.01	3.79E+06

a Loadings based on CY 1999 average fecal coliform concentration and mean flow reported on DMRs.

b Loadings based on Monthly Average fecal coliform permit limit at monthly average permitted flow (design flow used for facilities without a permitted monthly flow limit). A fecal coliform loading of 200 counts/100 mL was assumed for facilities without a fecal coliform bacteria permit limit.

Table 7 Livestock Distribution By County In The Oconee River Watershed (Source: USDA, 1977)

County	Livestock						
	Beef Cow	Milk Cow	Cattle	Chicken Layers	Chickens-Broilers Sold	Hogs	Sheep
Hall	9575	1554	18875	1373,149	44,321,204	1210	83
Jackson	15,336	104	26,076	1757,097	42,605,593	0	1315
Barrows	7009	110	12408	801,503	19,602,742	0	0
Clarke	0	0	3457	0	2,900,350	0	0
Oconee	6675	425	12,254	0	13,145,461	0	189
Oglethorpe	8019	1812	16,684	0	20,766,923	0	0
Greene	5644	3358	14,544	0	3853,171	16	0
Gwinnett	0	0	4803	0	1,967,683	22	22
Walton	6086	45	11,979	161,009	8,973,250	219	145
Morgan	7934	6083	23951	493,440	8,747,160	11,0 42	63
Putnam	2298	8838	16,490	0	0	0	0
Hancock	0	0	3555	57	0	0	0
Jasper	5407	1019	9983	525,752	914,348	0	157

County	Livestock						
	Beef Cow	Milk Cow	Cattle	Chicken Layers	Chickens-Broilers Sold	Hogs	Sheep
Newton	4695	213	8785	0	850,000	146	0
Jones	3265	1289	7264	0	1832,000	0	0
Baldwin	0	0	5483	0	896,552	169	0

Table 8 Fecal Coliform Loading Rates for Existing Conditions During Critical Period

Stream/Segment	Critical Conditions Period	Loading from NPDES Discharges (counts/30 days)	Loading from Surface Runoff and Other Direct Sources (counts/30 days)
Apalachee River - (Marburg Creek to Lake Oconee)	9/16 – 10/15/99	9.12×10^{12}	7.99×10^{13}
Apalachee River - (Williamson Creek to Marburg Creek)	9/16 – 10/15/99	0	1.55×10^{13}
Beaverdam Creek - (Oliver Creek to Lake Oconee)	8/27 – 9/25/97	0	1.33×10^{14}
Big Cedar Creek - (Hog Creek to Lake Sinclair)	8/13 – 9/11/92	0	6.84×10^{14}
Big Indian Creek - (I-20 to Little Indian Creek)	8/13 – 9/11/92	1.14×10^{10}	1.44×10^{14}
Big Sandy Creek - (Porter Creek to Oconee River)	8/11 – 9/9/90	5.00×10^{09}	7.97×10^{12}
Carr Creek - (Headwaters to North Oconee River)	9/9 – 10/8/96	0	5.36×10^{13}
Cedar Creek - (Headwaters to Oconee River)	9/9 – 10/8/96	4.55×10^{11}	5.32×10^{13}
Cedar Creek - (Headwaters to Winder Reservoir)	9/9 – 10/8/96	0	1.08×10^{13}
East Fork Trail Creek - (Headwaters to West Fork Trail Creek)	9/9 – 10/8/96	1.32×10^{10}	3.96×10^{13}
Little River - (Glady Creek to Lake Sinclair)	8/13 – 9/11/92	2.11×10^{11}	3.22×10^{15}
Little River - (Shoal Creek to Gap Creek)	8/13 – 9/11/92	1.02×10^{11}	1.45×10^{14}
Little River - (Social Circle to Nelson Cr)	8/13 – 9/11/92	1.02×10^{11}	7.68×10^{13}
Little Sugar Creek - (Headwaters to Lake Oconee)	8/27 – 9/25/97	0	2.33×10^{14}
Marburg Creek - (Masseys Lake to Apalachee River)	9/16 – 10/15/99	1.41×10^{11}	1.34×10^{13}
Middle Oconee River - (Big Bear Creek to McNutt Creek)	9/9 – 10/8/96	1.39×10^{12}	2.76×10^{14}
Middle Oconee River - (Mulberry River to Big Bear Creek)	9/9 – 10/8/96	2.28×10^{10}	1.22×10^{14}
Mulberry River - (Little Mulberry River to Middle Oconee)	9/9 – 10/8/96	0	3.85×10^{13}
North Oconee River - (Bordens Creek to Curry Creek)	9/9 – 10/8/96	2.03×10^{10}	4.28×10^{13}

Stream/Segment	**Critical Conditions Period**	**Loading from NPDES Discharges (counts/30 days)**	**Loading from Surface Runoff and Other Direct Sources (counts/30 days)**
North Oconee River - (Chandler Creek to Bordens Creek)	9/9 – 10/8/96	2.03×10^{10}	4.28×10^{13}
North Oconee River - (Jackson County to Sandy Creek)	9/9 – 10/8/96	8.63×10^{10}	4.28×10^{13}
North Oconee River - (Sandy Creek to Trail Creek)	9/9 – 10/8/96	8.63×10^{10}	1.08×10^{14}
North Oconee River - (Trail Creek to Oconee River)	9/9 – 10/8/96	2.56×10^{12}	4.28×10^{14}
Oconee River - (Barnett Shoals to Lake Oconee)	9/9 – 10/8/96	4.55×10^{12}	8.21×10^{14}
Oconee River - (Confluence of North & Middle Oconee River)	9/9 – 10/8/96	4.56×10^{12}	8.21×10^{14}
Oconee River - (Long Branch to Turkey Creek)	9/9 – 10/8/96	1.81×10^{10}	9.03×10^{13}
Richland Creek - (Interstate 20 to Beaverdam Creek)	8/27 – 9/25/97	0	2.80×10^{14}
Rooty Creek - (Rd. S926 Eatonton to Little Creek)	9/20 – 10/19/99	6.26×10^{10}	1.16×10^{13}
Tanyard Creek - (U/s North Oconee River)	9/9 – 10/8/96	0	3.96×10^{13}
Town Creek - (Hwy. 15 to Richland Creek)	8/27 – 9/25/97	2.27×10^{11}	8.66×10^{13}
Turkey Creek - (Horse Branch to Rocky Creek)	6/14 – 7/13/90	9.48×10^{10}	1.34×10^{12}
Turkey Creek - (Rocky Creek to Oconee River)	6/14 – 7/13/90	1.12×10^{11}	2.56×10^{12}

Table 9 TMDL Components

Stream/Segment	WLAs (counts/30 days)	LAs (counts/30 days)	Margin of Safety (counts/30 days)	TMDL (counts/30 days)	Percent Reduction
Apalachee River - (Marburg Creek to Lake Oconee)	9.12×10^{12}	1.97×10^{13}	2.19×10^{12}	2.28×10^{13}	73
Apalachee River - (Williamson Creek to Marburg Creek)	0	3.85×10^{12}	4.28×10^{11}	4.28×10^{12}	77
Beaverdam Creek - (Oliver creek to Lake Oconee)	0	1.97×10^{13}	2.19×10^{12}	2.19×10^{13}	84
Big Cedar Creek - (Hog Creek to Lake Sinclair)	0	1.25×10^{14}	1.39×10^{13}	1.39×10^{14}	80
Big Indian Creek - (I-20 to Little Indian Creek)	1.14×10^{10}	3.52×10^{13}	3.91×10^{12}	3.91×10^{13}	73
Big Sandy Creek - (Porter Creek to Oconee River)	5.00×10^{09}	7.59×10^{11}	8.43×10^{10}	8.48×10^{11}	89
Carr Creek - (Headwaters to North Oconee River)	0	1.14×10^{13}	1.27×10^{12}	1.27×10^{13}	76
Cedar Creek - (Headwaters to Oconee River)	4.55×10^{11}	1.14×10^{13}	1.27×10^{12}	1.31×10^{13}	76
Cedar Creek - (Headwaters to Winder Reservoir)	0	1.13×10^{12}	1.26×10^{11}	1.26×10^{12}	88
East Fork Trail Creek - (Headwaters to West Fork Trail Creek)	1.32×10^{10}	8.53×10^{12}	9.48×10^{11}	9.49×10^{12}	76
Little River - (Glady Creek to Lake Sinclair)	2.11×10^{11}	1.69×10^{15}	1.87×10^{14}	1.87×10^{15}	50
Little River - (Shoal Creek to Gap Creek)	1.02×10^{11}	3.56×10^{13}	3.95×10^{12}	3.96×10^{13}	73
Little River - (Social Circle to Nelson Creek)	1.02×10^{11}	2.86×10^{13}	3.18×10^{12}	3.19×10^{13}	59
Little Sugar Creek - (Headwaters to Lake Oconee)	0	5.39×10^{13}	5.99×10^{12}	5.99×10^{13}	74
Marburg Creek - (Masseys Lake to Apalachee River)	1.41×10^{11}	2.77×10^{12}	3.08×10^{11}	3.22×10^{12}	77

Stream/Segment	WLAs (counts/30 days)	LAs (counts/30 days)	Margin of Safety (counts/30 days)	TMDL (counts/30 days)	Percent Reduction
Middle Oconee River - (Big Bear Creek to McNutt Creek)	1.39×10^{12}	1.94×10^{14}	2.15×10^{13}	2.17×10^{14}	22
Middle Oconee River - (Mulberry River to Big Bear Creek)	2.28×10^{10}	6.27×10^{13}	6.97×10^{12}	6.97×10^{13}	43
Mulberry River - (Little Mulberry River to Middle Oconee)	0	1.94×10^{13}	2.15×10^{12}	2.15×10^{13}	44
North Oconee River - (Bordens Creek to Curry Creek)	2.03×10^{10}	1.56×10^{13}	1.73×10^{12}	1.73×10^{13}	60
North Oconee River - (Chandler Creek to Bordens Creek)	2.03×10^{10}	1.56×10^{13}	1.73×10^{12}	1.73×10^{13}	60
North Oconee River - (Jackson County to Sandy Creek)	8.63×10^{10}	3.94×10^{13}	4.38×10^{12}	4.39×10^{13}	60
North Oconee River - (Sandy Creek to Trail Creek)	8.63×10^{10}	3.94×10^{13}	4.38×10^{12}	4.39×10^{13}	60
North Oconee River - (Trail Creek to Oconee River)	2.56×10^{12}	1.08×10^{14}	1.20×10^{13}	1.22×10^{14}	72
Oconee River - (Barnett Shoals to Lake Oconee)	4.55×10^{12}	5.23×10^{14}	5.81×10^{13}	5.86×10^{14}	35
Oconee River - (Confluence of North & Middle Oconee River)	4.56×10^{12}	3.77×10^{14}	4.19×10^{13}	4.24×10^{14}	49

Stream/Segment	WLAs (counts/30 days)	LAs (counts/30 days)	Margin of Safety (counts/30 days)	TMDL (counts/30 days)	Percent Reduction
Oconee River - (Long Branch to Turkey Creek)	1.81×10^{10}	5.77×10^{13}	6.41×10^{12}	7.71×10^{13}	25
Richland Creek - (Interstate 20 to Beaverdam Creek)	0	2.95×10^{13}	3.28×10^{12}	3.28×10^{13}	88
Rooty Creek - (Rd. S926 Eatonton to Little Creek)	6.26×10^{10}	3.99×10^{12}	4.44×10^{11}	4.50×10^{12}	74
Tanyard Creek - (U/s North Oconee River)	0	1.10×10^{13}	1.22×10^{12}	1.22×10^{13}	76
Town Creek - (Hwy. 15 to Richland Creek)	2.27×10^{11}	1.91×10^{12}	2.13×10^{11}	2.35×10^{12}	97
Turkey Creek - (Horse Branch to Rocky Creek)	9.48×10^{10}	6.13×10^{11}	6.81×10^{10}	7.76×10^{11}	51
Turkey Creek - (Rocky Creek to Oconee River)	1.12×10^{11}	8.03×10^{11}	8.92×10^{10}	1.00×10^{12}	62

Table 10. Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Agriculture	1. Sediment & Erosion Control	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	1. Preharvest Planning				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
	10. Wetlands Forest Management	–	–	–		–		–		
Urban	1. New Development	_	_		_	_			_	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	_	_		_	_			_	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
	4. Operation and Maintenance- Roads, Highways and Bridges	–	–			–			–	

APPENDIX A:

HYDROLOGY CALIBRATIONS

Table A1 - Calibration and Validation Stations for Hydrological Parameters

Above the GA Fall Line (Piedmont)

Station Number	Station Name	Type	Drainage Area (acres)	Reference WDM station
02204070	South River at Klondike Road	Calibration	117978	Atlanta Hartsfield
02219000	Apalachee River near Bostwick, GA	Validation	119738	Monroe
02217500	Middle Oconee River near Athens, GA	Validation	252006	Jefferson
02220900	Little River near Eatonton, GA	Validation	174445	Milledgeville
02221525	Murder Creek Below Eatonton, GA	Validation	121690	Milledgeville
02208450	Alcovy River above Covington, GA	Validation	122720	Monroe
02213000	Ocmulgee River at Macon, GA	Validation	1450880	Macon Lewis

Table A2 - Calibration and Validation Stations for Hydrological Parameters Below the GA Fall Line (Coastal Plain)

Station Number	Station Name	Type	Drainage Area (acres)	Reference WDM station
02225500	Ohoopee River near Reidsville, GA	Calibration	735216	Dublin
02215500	Ocmulgee River at Lumber City, GA	Validation	3366386	Abbeville
02223500	Oconee River at Dublin, GA	Validation	2804097	Milledgeville
02225000	Altamaha River near Baxley, GA	Validation	7414025	Hazlehurst
02226000	Altamaha River at Doctortown, GA	Validation	8738182	Jesup

Figure A.1. Location of Hydrology Calibration and Validation Stations

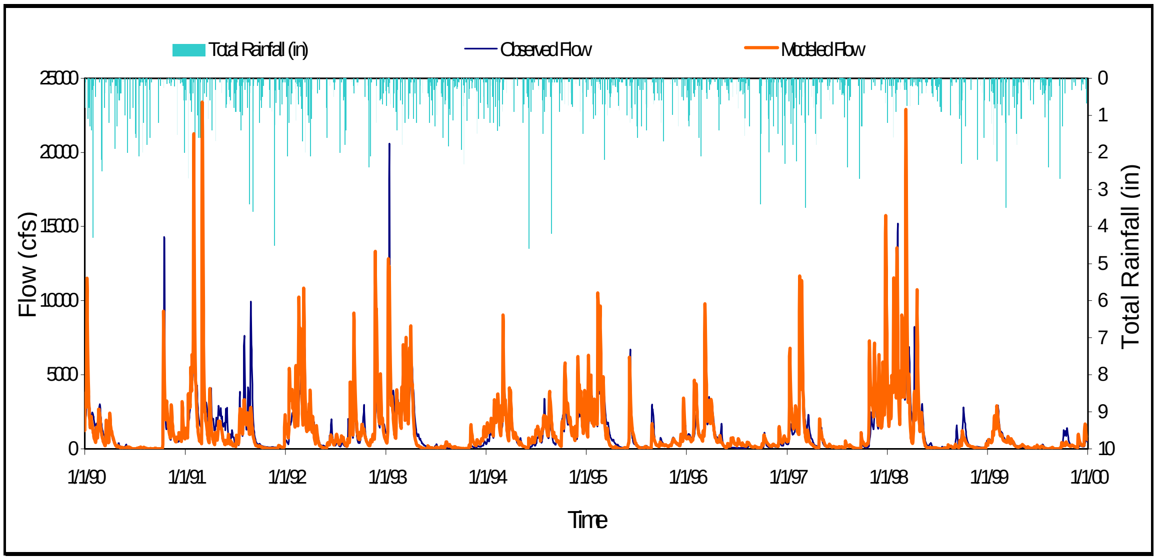


Figure A.2. 10-Year Calibration (Daily Flow) at 02225500 – Ohoopee River near Reidsville, GA.

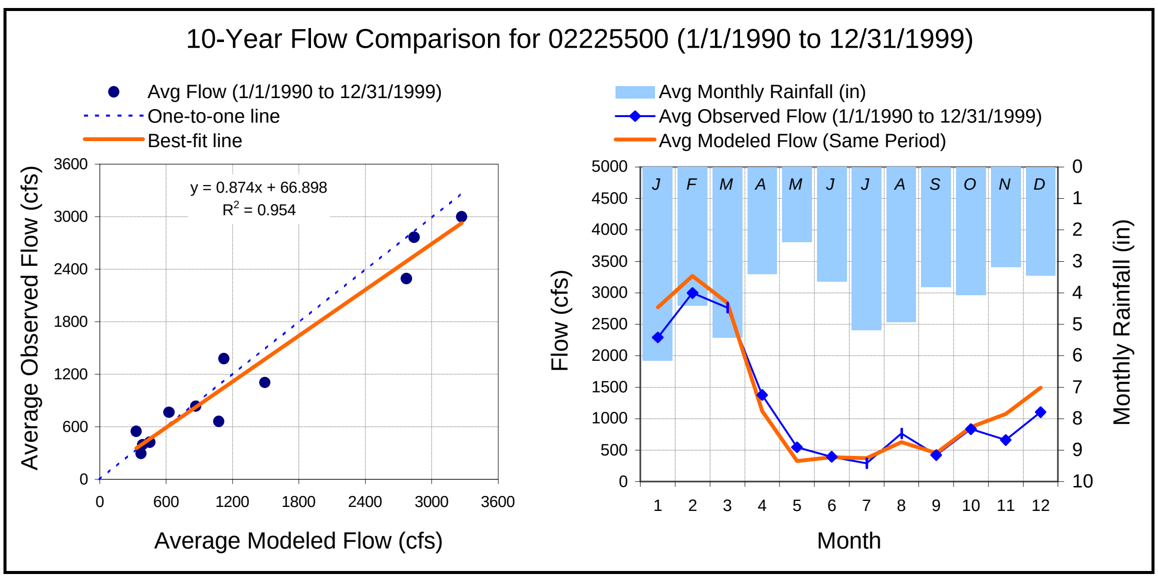


Figure A.3. 10-Year Calibration (Monthly Average) at 02225500 – Ohoopee River near Reidsville, GA.

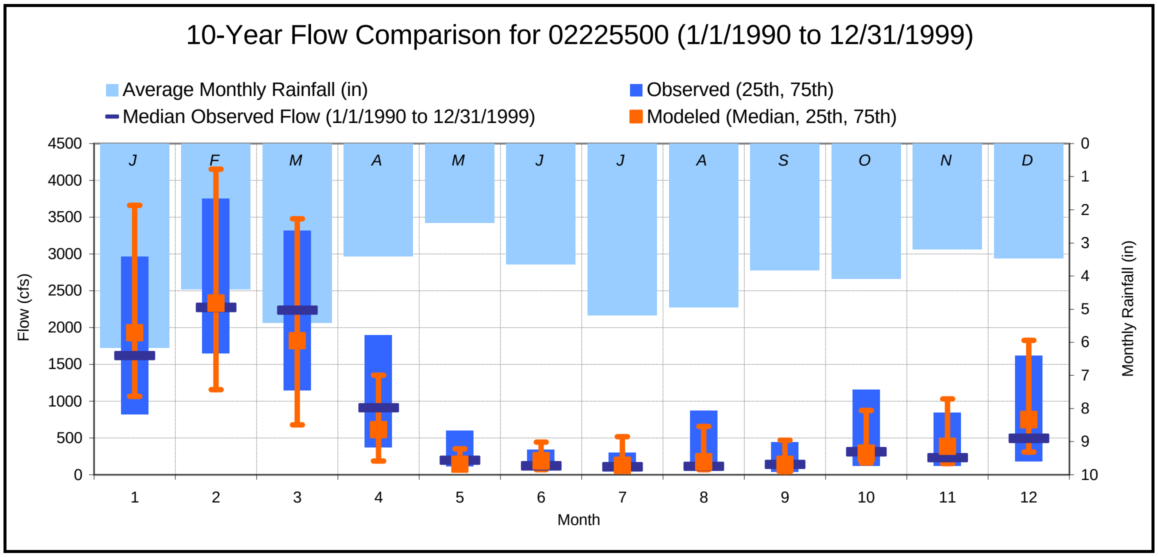
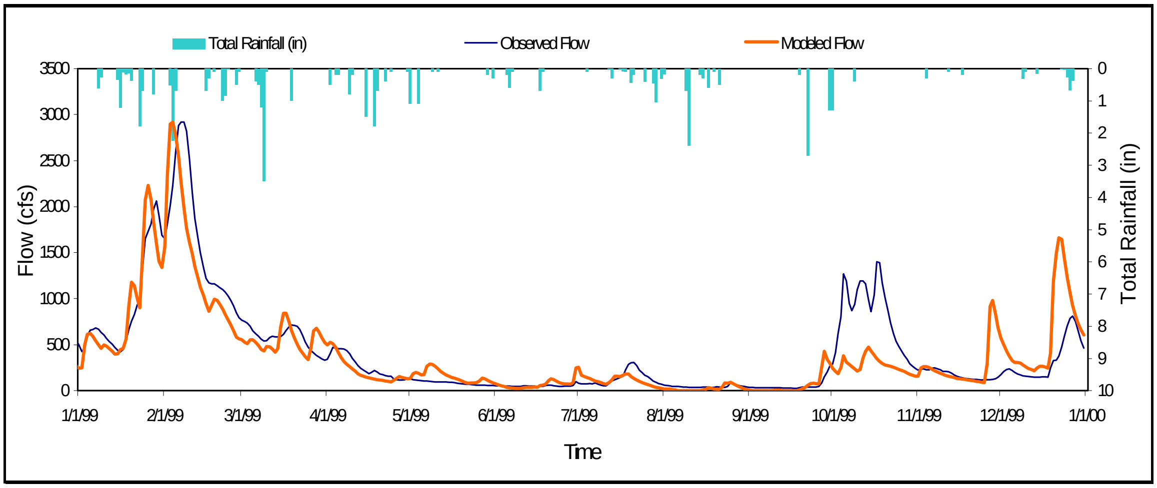


Figure A.4. 10-Year Calibration (Monthly Medians) at 02225500 – Ohoopee River near Reidsville, GA.

Simulation Name:	02225500	**Simulation Period:**	
		Watershed Area (ac):	730428.00
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**153.74**	Total Observed In-stream Flow:	**142.28**
Total of highest 10% flows:	**76.16**	Total of Observed highest 10% flows:	**63.14**
Total of lowest 50% flows:	**9.69**	Total of Observed Lowest 50% flows:	**9.59**
Simulated Summer Flow Volume (months 7-9):	**14.54**	Observed Summer Flow Volume (7-9):	**14.79**
Simulated Fall Flow Volume (months 10-12):	**34.37**	Observed Fall Flow Volume (10-12):	**26.02**
Simulated Winter Flow Volume (months 1-3):	**86.76**	Observed Winter Flow Volume (1-3):	**78.63**
Simulated Spring Flow Volume (months 4-6):	**18.07**	Observed Spring Flow Volume (4-6):	**22.84**
Total Simulated Storm Volume:	**153.40**	Total Observed Storm Volume:	**138.34**
Simulated Summer Storm Volume (7-9):	**14.46**	Observed Summer Storm Volume (7-9):	**13.80**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**7.45**	10	
Error in 50% lowest flows:	**1.04**	10	
Error in 10% highest flows:	**17.10**	15	
Seasonal volume error - Summer:	**-1.72**	30	
Seasonal volume error - Fall:	**24.29**	30	
Seasonal volume error - Winter:	**9.36**	30	
Seasonal volume error - Spring:	**-26.38**	30	
Error in storm volumes:	**9.81**	20	
Error in summer storm volumes:	**4.52**	50	

Figure A.5. 10-Year Calibration Statistics at 02225500 – Ohoopee River near Reidsville, GA.

Figure A.6. Calendar Year 1999 (Daily Flow) at 02225500 – Ohoopee River near



Reidsville, GA.

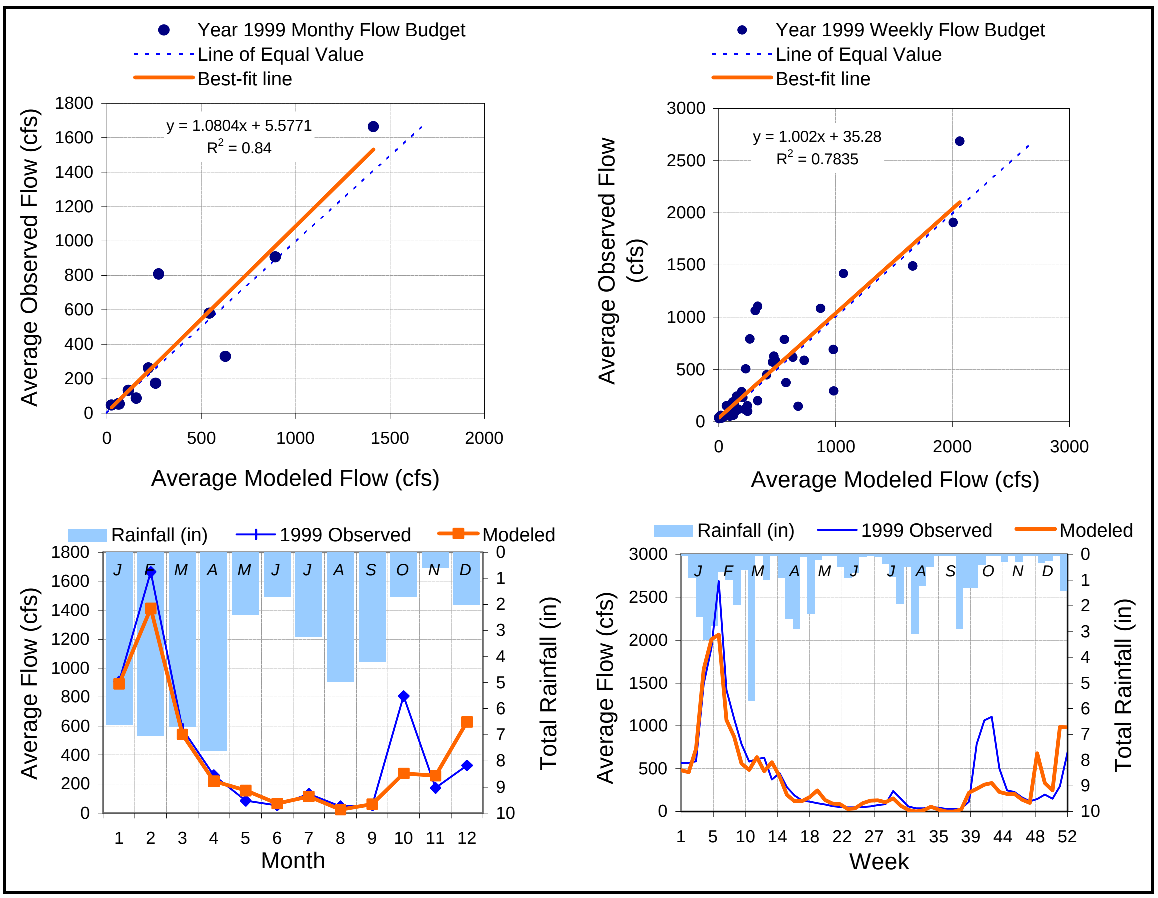


Figure A.7. Calendar Year 1999 (Monthly and Weekly) at 02225500 – Ohoopee River near Reidsville, GA.

Simulation Name:	02225500	**Simulation Period:**	
		Watershed Area (ac):	730428.00
Selected a Year for Flow Analysis:	**1999**		
Type of Year (1=Calendar, 2=Water Year)	**1**	**Baseflow PERCENTILE:**	2.5
Calendar Year 1999:		*Usually 1%-5%*	
1/1/1999 to 12/31/1999			
Total Simulated In-stream Flow:	**4.54**	Total Observed In-stream Flow:	**4.96**
Total of highest 10% flows:	**1.95**	Total of Observed highest 10% flows:	**2.08**
Total of lowest 50% flows:	**0.50**	Total of Observed Lowest 50% flows:	**0.47**
Simulated Summer Flow Volume (months 7-9):	**0.20**	Observed Summer Flow Volume (7-9):	**0.23**
Simulated Fall Flow Volume (months 10-12):	**1.17**	Observed Fall Flow Volume (10-12):	**1.32**
Simulated Winter Flow Volume (months 1-3):	**2.74**	Observed Winter Flow Volume (1-3):	**3.02**
Simulated Spring Flow Volume (months 4-6):	**0.44**	Observed Spring Flow Volume (4-6):	**0.39**
Total Simulated Storm Volume:	**4.52**	Total Observed Storm Volume:	**4.60**
Simulated Summer Storm Volume (7-9):	**0.20**	Observed Summer Storm Volume (7-9):	**0.14**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**-9.32**	10	
Error in 50% lowest flows:	**5.09**	10	
Error in 10% highest flows:	**-6.78**	15	
Seasonal volume error - Summer:	**-16.27**	30	
Seasonal volume error - Fall:	**-13.02**	30	
Seasonal volume error - Winter:	**-10.35**	30	
Seasonal volume error - Spring:	**10.12**	30	
Error in storm volumes:	**-1.56**	20	
Error in summer storm volumes:	**28.69**	50	

Figure A.8. Calendar Year 1999 Statistics at 02225500 – Ohoopee River near Reidsville, GA.

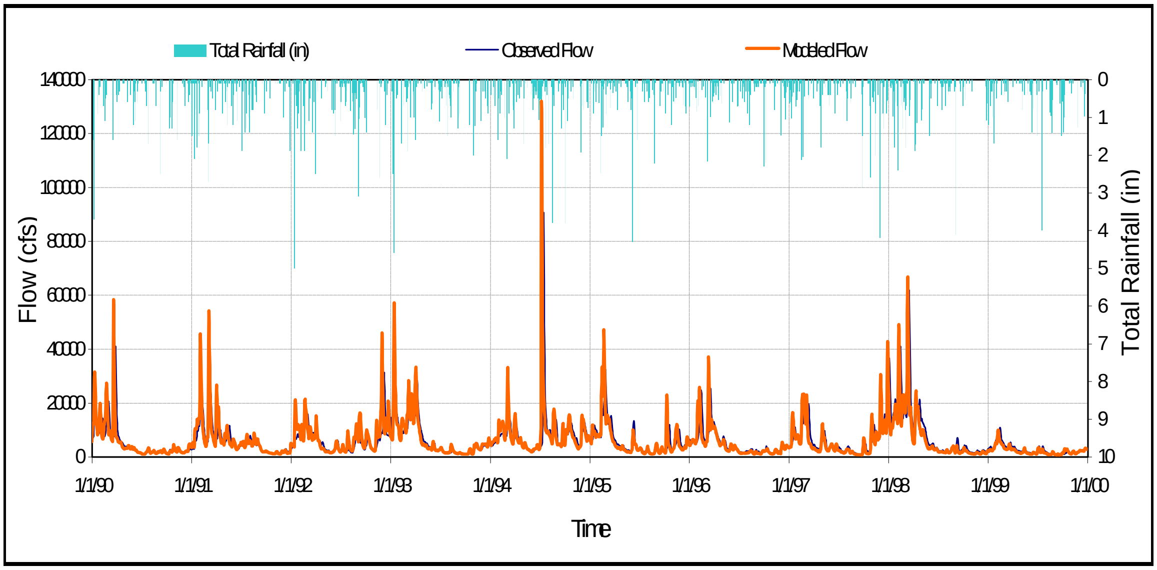


Figure A.9. 10-Year Validation (Daily Flow) at 02215500 – Ocmulgee River at Lumber City, GA.

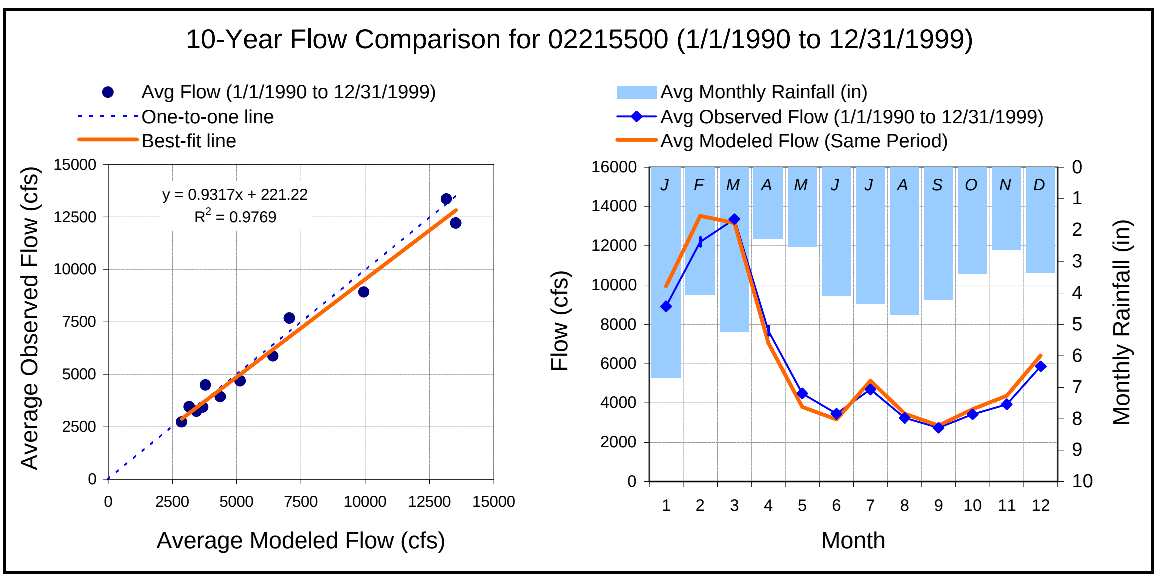


Figure A.10. 10-Year Validation (Monthly Average) at 02215500 – Ocmulgee River at Lumber City, GA.

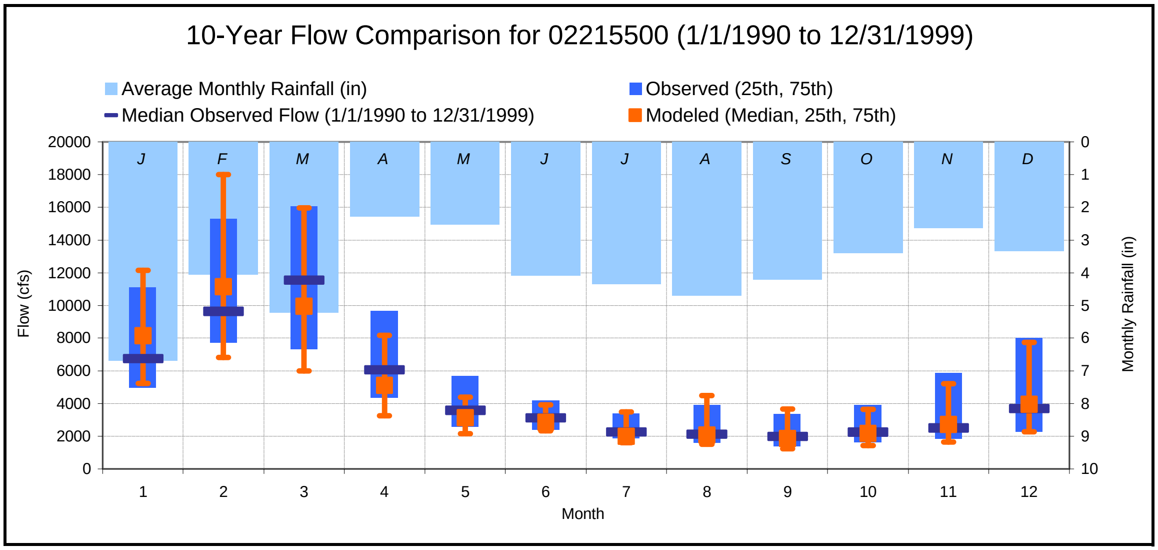


Figure A.11. 10-Year Validation (Monthly Medians) at 02215500 – Ocmulgee River at Lumber City, GA.

Simulation Name:	02215500	**Simulation Period:**	
		Watershed Area (ac):	3366386
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**163.87**	Total Observed In-stream Flow:	**158.47**
Total of highest 10% flows:	**61.83**	Total of Observed highest 10% flows:	**53.58**
Total of lowest 50% flows:	**27.34**	Total of Observed Lowest 50% flows:	**30.16**
Simulated Summer Flow Volume (months 7-9):	**24.86**	Observed Summer Flow Volume (7-9):	**23.16**
Simulated Fall Flow Volume (months 10-12):	**31.41**	Observed Fall Flow Volume (10-12):	**28.73**
Simulated Winter Flow Volume (months 1-3):	**77.60**	Observed Winter Flow Volume (1-3):	**73.13**
Simulated Spring Flow Volume (months 4-6):	**29.99**	Observed Spring Flow Volume (4-6):	**33.45**
Total Simulated Storm Volume:	**136.76**	Total Observed Storm Volume:	**126.78**
Simulated Summer Storm Volume (7-9):	**18.11**	Observed Summer Storm Volume (7-9):	**15.23**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**3.29**	10	
Error in 50% lowest flows:	**-10.33**	10	
Error in 10% highest flows:	**13.35**	15	
Seasonal volume error - Summer:	**6.84**	30	
Seasonal volume error - Fall:	**8.53**	30	
Seasonal volume error - Winter:	**5.76**	30	
Seasonal volume error - Spring:	**-11.51**	30	
Error in storm volumes:	**7.29**	20	
Error in summer storm volumes:	**15.93**	50	

Figure A.12. 10-Year Validation Statistics at 02215500 – Ocmulgee River at Lumber City, GA.

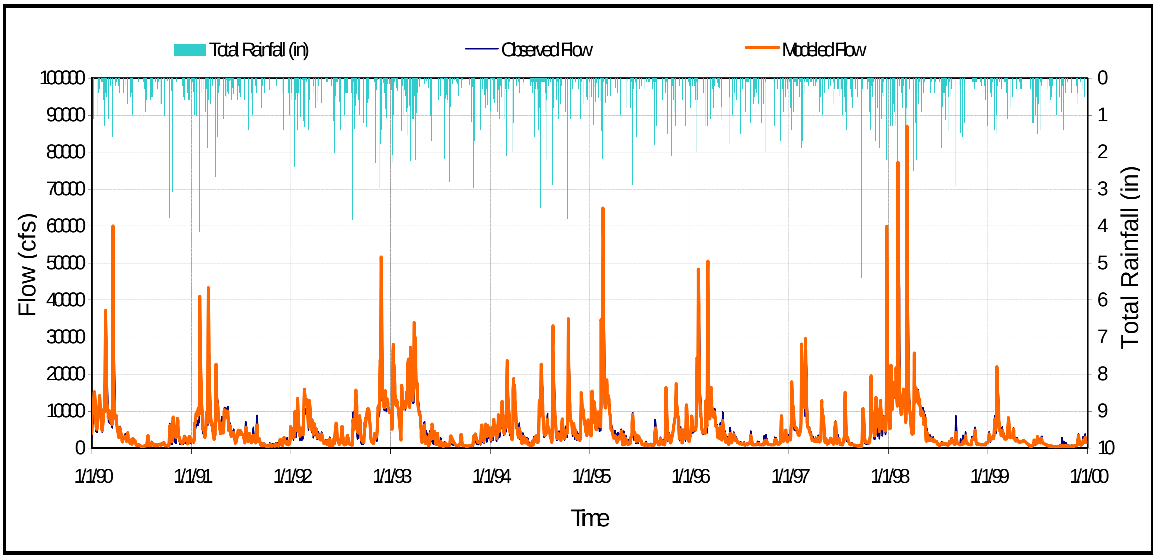


Figure A.13. 10-Year Validation (Daily Flow) at 02223500 – Oconee River at Dublin, GA.

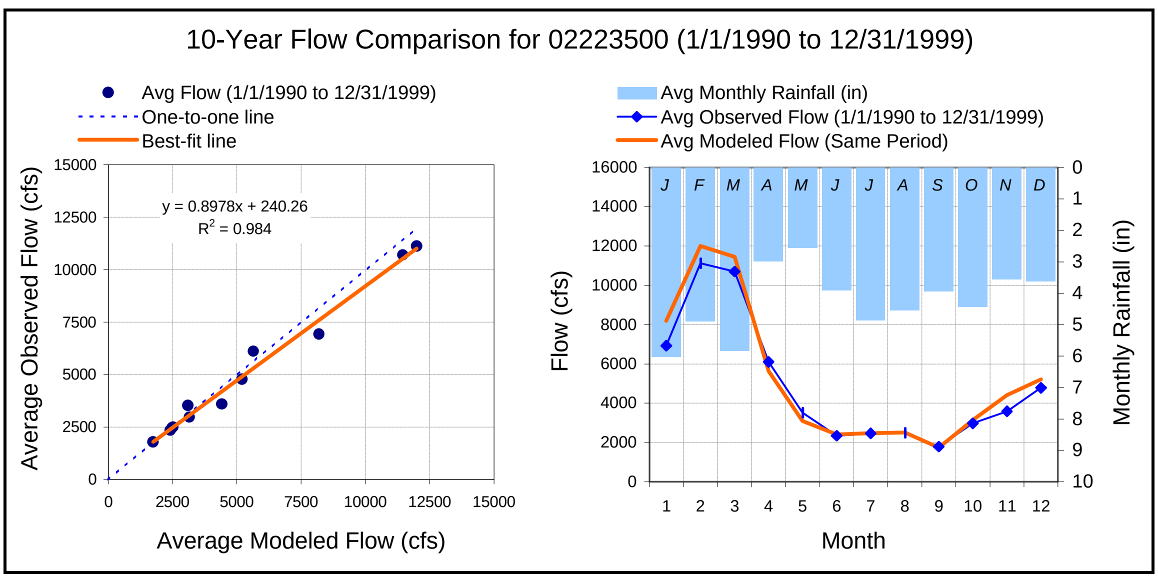


Figure A.14 10-Year Validation (Monthly Average) at 02223500 – Oconee River at Dublin, GA.

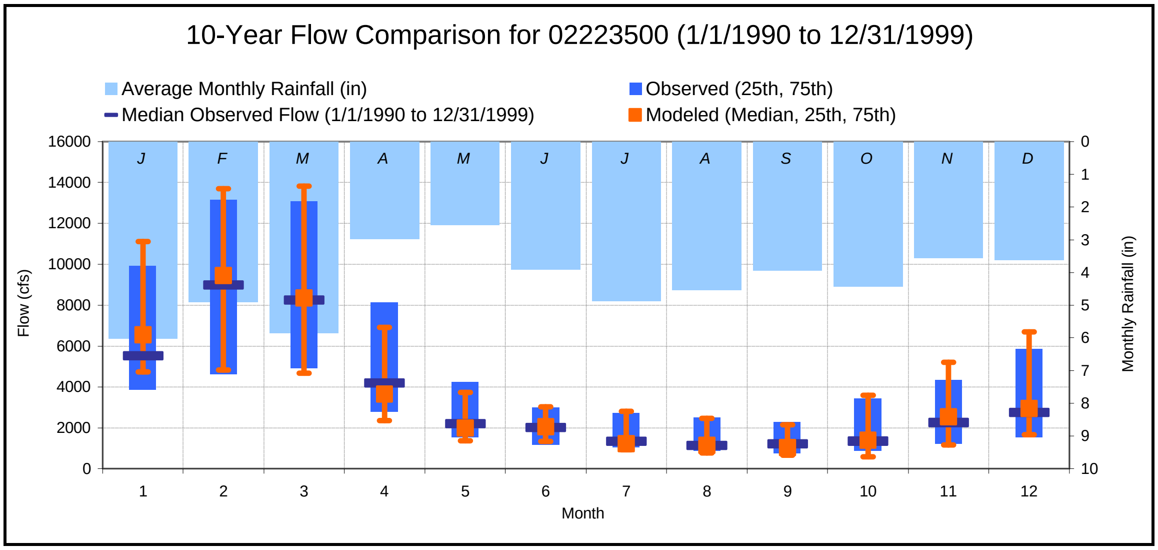


Figure A.15. 10-Year Validation (Monthly Medians) at 02223500 – Oconee River at Dublin, GA.

Simulation Name:	02223500	**Simulation Period:**	
		Watershed Area (ac):	2804097
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**159.89**	Total Observed In-stream Flow:	**150.96**
Total of highest 10% flows:	**63.23**	Total of Observed highest 10% flows:	**56.09**
Total of lowest 50% flows:	**21.46**	Total of Observed Lowest 50% flows:	**22.45**
Simulated Summer Flow Volume (months 7-9):	**17.58**	Observed Summer Flow Volume (7-9):	**17.62**
Simulated Fall Flow Volume (months 10-12):	**33.23**	Observed Fall Flow Volume (10-12):	**29.53**
Simulated Winter Flow Volume (months 1-3):	**80.43**	Observed Winter Flow Volume (1-3):	**73.00**
Simulated Spring Flow Volume (months 4-6):	**28.64**	Observed Spring Flow Volume (4-6):	**30.81**
Total Simulated Storm Volume:	**145.27**	Total Observed Storm Volume:	**132.05**
Simulated Summer Storm Volume (7-9):	**13.93**	Observed Summer Storm Volume (7-9):	**12.90**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**5.59**	10	
Error in 50% lowest flows:	**-4.62**	10	
Error in 10% highest flows:	**11.30**	15	
Seasonal volume error - Summer:	**-0.22**	30	
Seasonal volume error - Fall:	**11.13**	30	
Seasonal volume error - Winter:	**9.24**	30	
Seasonal volume error - Spring:	**-7.55**	30	
Error in storm volumes:	**9.10**	20	
Error in summer storm volumes:	**7.39**	50	

Figure A.16. 10-Year Validation Statistics at 02223500 – Oconee River at Dublin, GA.

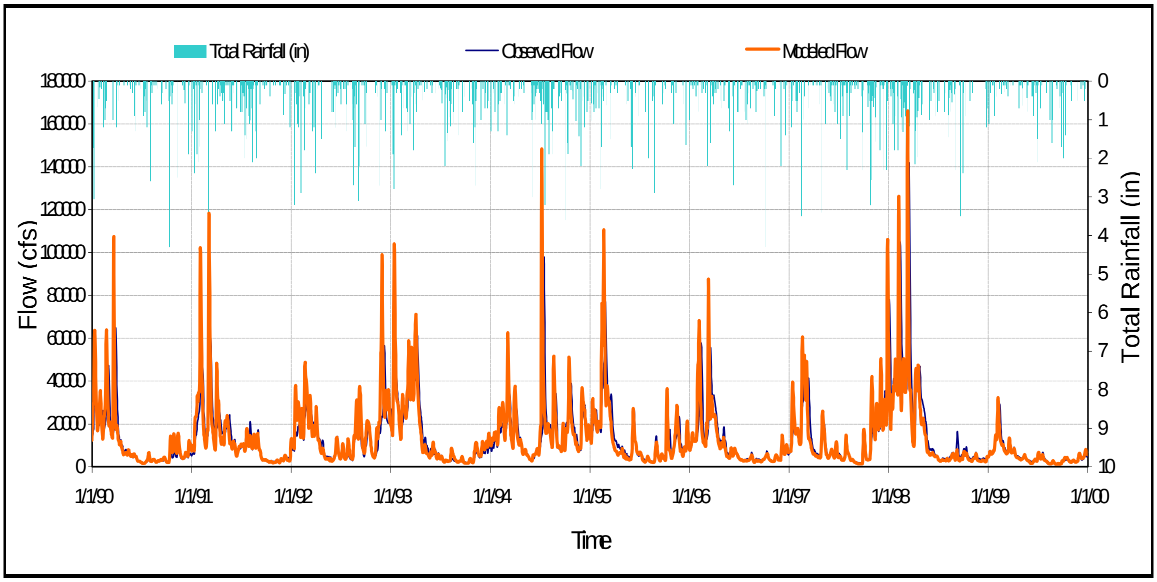


Figure A.17. 10-Year Validation (Daily Flow) at 02225000 – Altamaha River near Baxley, GA.

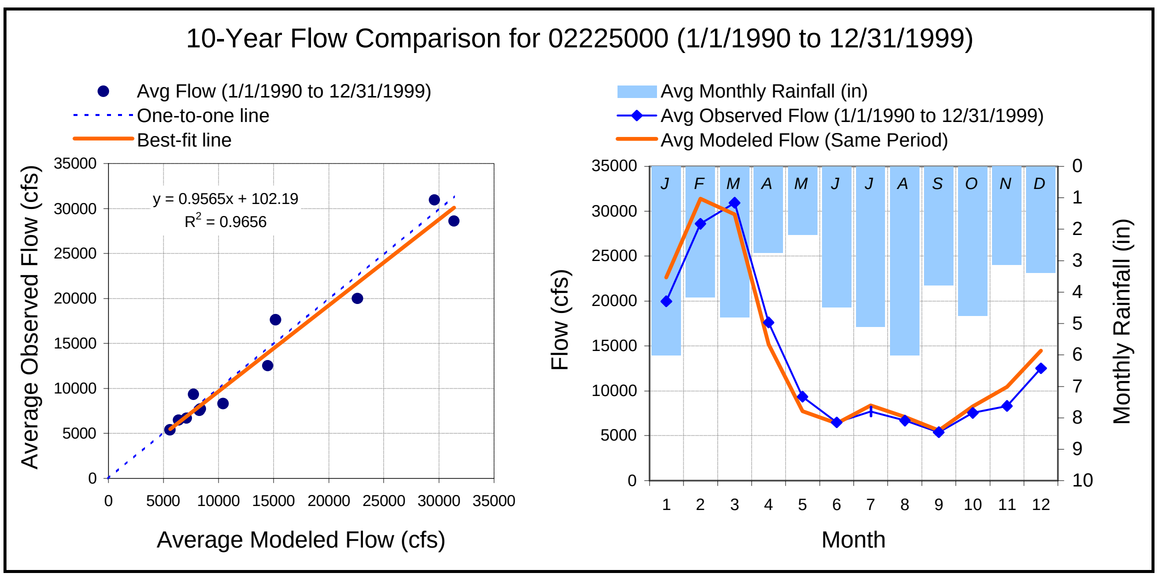


Figure A.18. 10-Year Validation (Monthly Average) at 02225000 – Altamaha River near Baxley, GA.

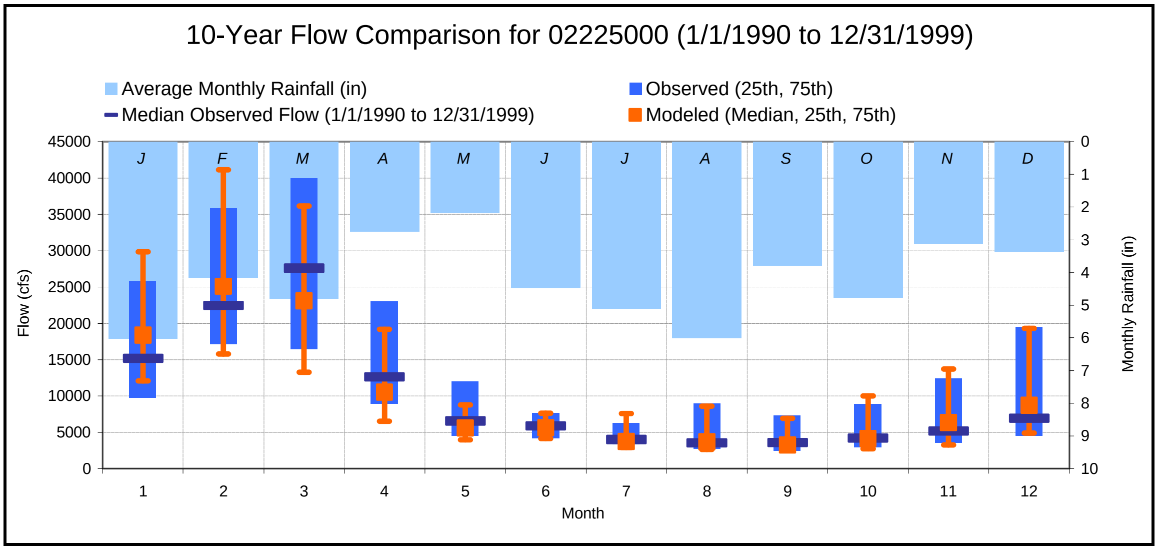


Figure A.19. 10-Year Validation (Monthly Medians) at 02225000 – Altamaha River near Baxley, GA.

Simulation Name:	02225000	**Simulation Period:**	
		Watershed Area (ac):	7414025
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**162.30**	Total Observed In-stream Flow:	**156.52**
Total of highest 10% flows:	**61.54**	Total of Observed highest 10% flows:	**55.32**
Total of lowest 50% flows:	**24.30**	Total of Observed Lowest 50% flows:	**25.45**
Simulated Summer Flow Volume (months 7-9):	**20.78**	Observed Summer Flow Volume (7-9):	**19.53**
Simulated Fall Flow Volume (months 10-12):	**32.68**	Observed Fall Flow Volume (10-12):	**27.94**
Simulated Winter Flow Volume (months 1-3):	**80.39**	Observed Winter Flow Volume (1-3):	**76.56**
Simulated Spring Flow Volume (months 4-6):	**28.45**	Observed Spring Flow Volume (4-6):	**32.50**
Total Simulated Storm Volume:	**141.79**	Total Observed Storm Volume:	**132.50**
Simulated Summer Storm Volume (7-9):	**15.67**	Observed Summer Storm Volume (7-9):	**13.53**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**3.56**	10	
Error in 50% lowest flows:	**-4.72**	10	
Error in 10% highest flows:	**10.10**	15	
Seasonal volume error - Summer:	**6.06**	30	
Seasonal volume error - Fall:	**14.50**	30	
Seasonal volume error - Winter:	**4.77**	30	
Seasonal volume error - Spring:	**-14.24**	30	
Error in storm volumes:	**6.56**	20	
Error in summer storm volumes:	**13.68**	50	

Figure A.20. 10-Year Validation Statistics at 02225000 – Altamaha River near Baxley, GA.

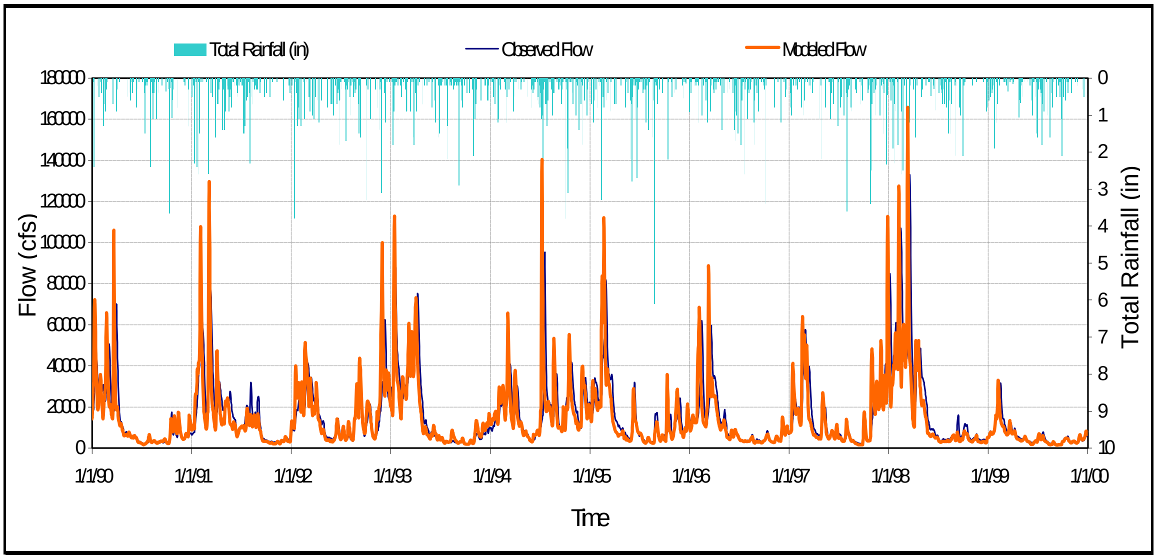


Figure A.21. 10-Year Validation (Daily Flow) at 02226000 – Altamaha River at Doctortown, GA.

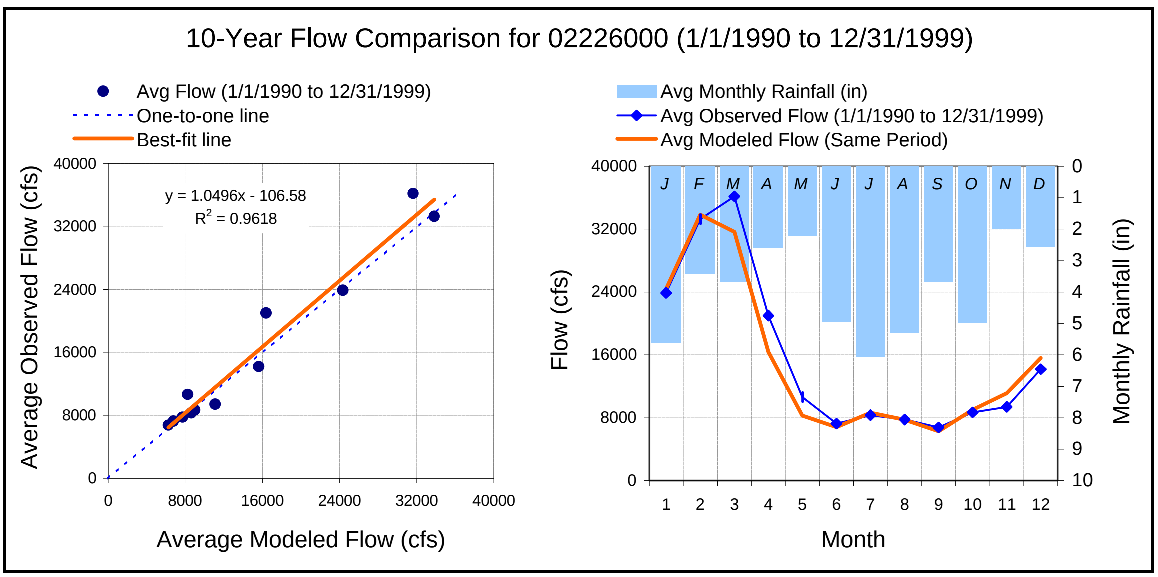


Figure A.22. 10-Year Validation (Monthly Average) at 02226000 – Altamaha River at Doctortown, GA.

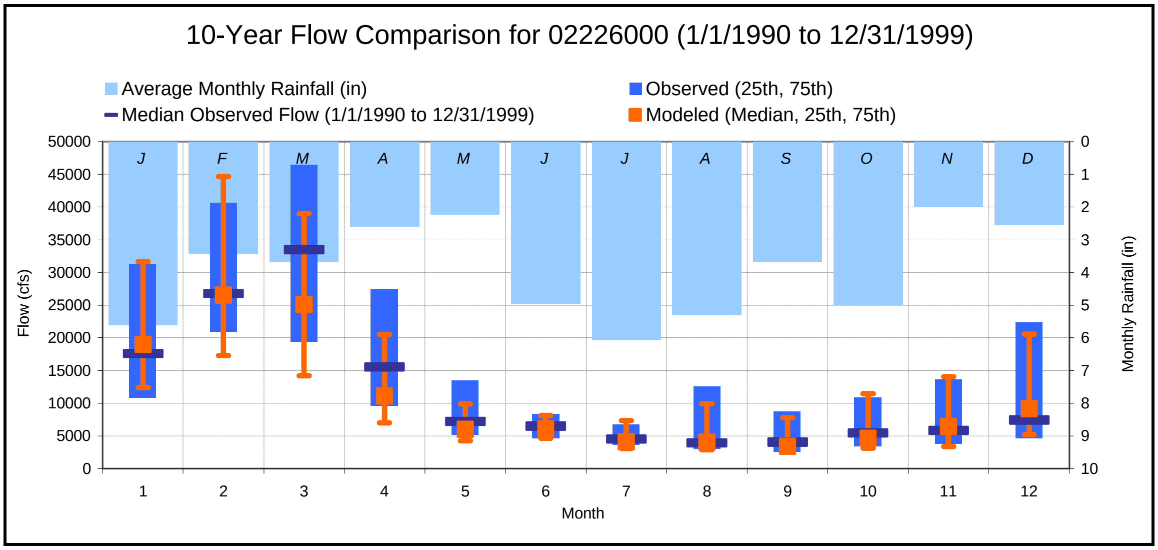


Figure A.23. 10-Year Validation (Monthly Medians) at 02226000 – Altamaha River at Doctortown, GA.

Simulation Name:	02226000	**Simulation Period:**	
		Watershed Area (ac):	8738182
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**148.01**	Total Observed In-stream Flow:	**154.40**
Total of highest 10% flows:	**55.97**	Total of Observed highest 10% flows:	**54.45**
Total of lowest 50% flows:	**22.16**	Total of Observed Lowest 50% flows:	**23.94**
Simulated Summer Flow Volume (months 7-9):	**18.93**	Observed Summer Flow Volume (7-9):	**19.10**
Simulated Fall Flow Volume (months 10-12):	**29.89**	Observed Fall Flow Volume (10-12):	**26.97**
Simulated Winter Flow Volume (months 1-3):	**73.27**	Observed Winter Flow Volume (1-3):	**76.27**
Simulated Spring Flow Volume (months 4-6):	**25.92**	Observed Spring Flow Volume (4-6):	**32.06**
Total Simulated Storm Volume:	**128.79**	Total Observed Storm Volume:	**132.15**
Simulated Summer Storm Volume (7-9):	**14.13**	Observed Summer Storm Volume (7-9):	**13.53**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**-4.32**	10	
Error in 50% lowest flows:	**-8.01**	10	
Error in 10% highest flows:	**2.72**	15	
Seasonal volume error - Summer:	**-0.90**	30	
Seasonal volume error - Fall:	**9.77**	30	
Seasonal volume error - Winter:	**-4.09**	30	
Seasonal volume error - Spring:	**-23.71**	30	
Error in storm volumes:	**-2.61**	20	
Error in summer storm volumes:	**4.26**	50	

Figure A.24. 10-Year Validation Statistics at 02226000 – Altamaha River at Doctortown, GA.

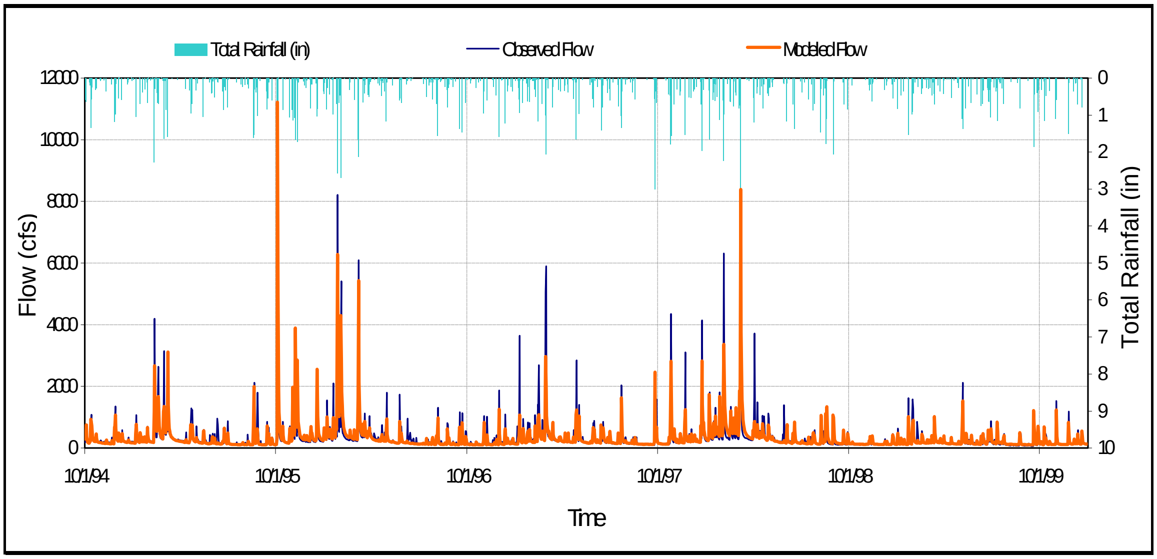


Figure A.25. 5.2-Year Calibration (Daily Flow) at 02204070 – South River at Klondike Road.

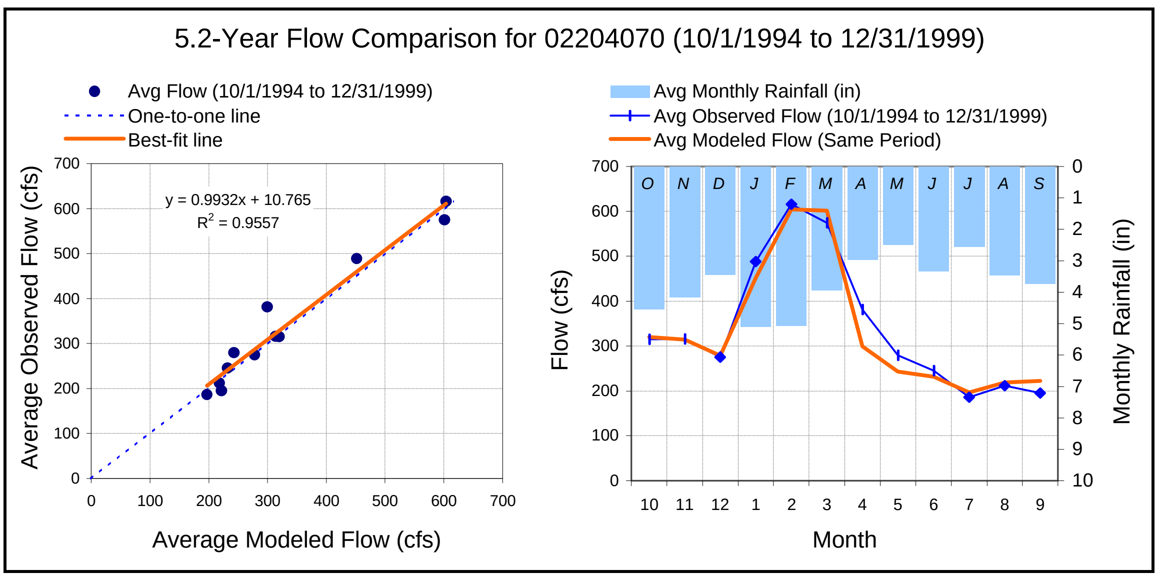


Figure A.26. 5.2-Year Calibration (Monthly Average) at 02204070 – South River at Klondike Road.

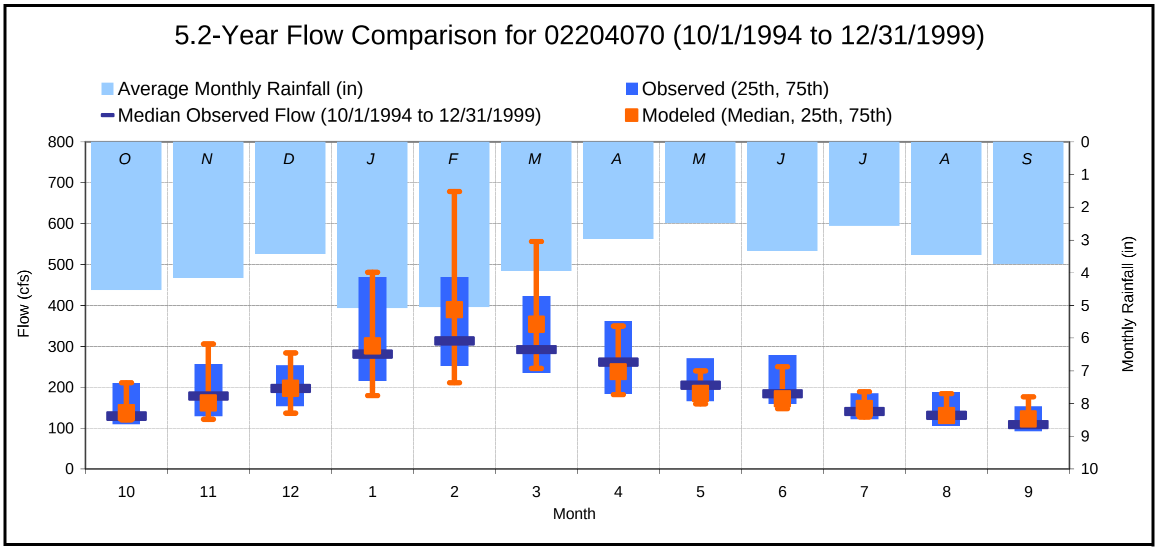


Figure A.27. 5.2-Year Calibration (Monthly Medians) at 02204070 – South River at Klondike Road.

Simulation Name:	02204070	**Simulation Period:**	
		Watershed Area (ac):	117978
Period for Flow Analysis			
Begin Date:	**10/01/94**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**127.39**	Total Observed In-stream Flow:	**130.44**
Total of highest 10% flows:	**50.64**	Total of Observed highest 10% flows:	**58.20**
Total of lowest 50% flows:	**27.00**	Total of Observed Lowest 50% flows:	**26.39**
Simulated Summer Flow Volume (months 7-9):	**19.70**	Observed Summer Flow Volume (7-9):	**18.35**
Simulated Fall Flow Volume (months 10-12):	**33.85**	Observed Fall Flow Volume (10-12):	**33.63**
Simulated Winter Flow Volume (months 1-3):	**50.13**	Observed Winter Flow Volume (1-3):	**50.76**
Simulated Spring Flow Volume (months 4-6):	**23.70**	Observed Spring Flow Volume (4-6):	**27.71**
Total Simulated Storm Volume:	**85.31**	Total Observed Storm Volume:	**98.06**
Simulated Summer Storm Volume (7-9):	**9.62**	Observed Summer Storm Volume (7-9):	**10.67**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**-2.40**	10	
Error in 50% lowest flows:	**2.25**	10	
Error in 10% highest flows:	**-14.92**	15	
Seasonal volume error - Summer:	**6.87**	30	
Seasonal volume error - Fall:	**0.65**	30	
Seasonal volume error - Winter:	**-1.24**	30	
Seasonal volume error - Spring:	**-16.90**	30	
Error in storm volumes:	**-14.94**	20	
Error in summer storm volumes:	**-10.85**	50	

Figure A.28. 5.2-Year Calibration Statistics at 02204070 – South River at Klondike Road.

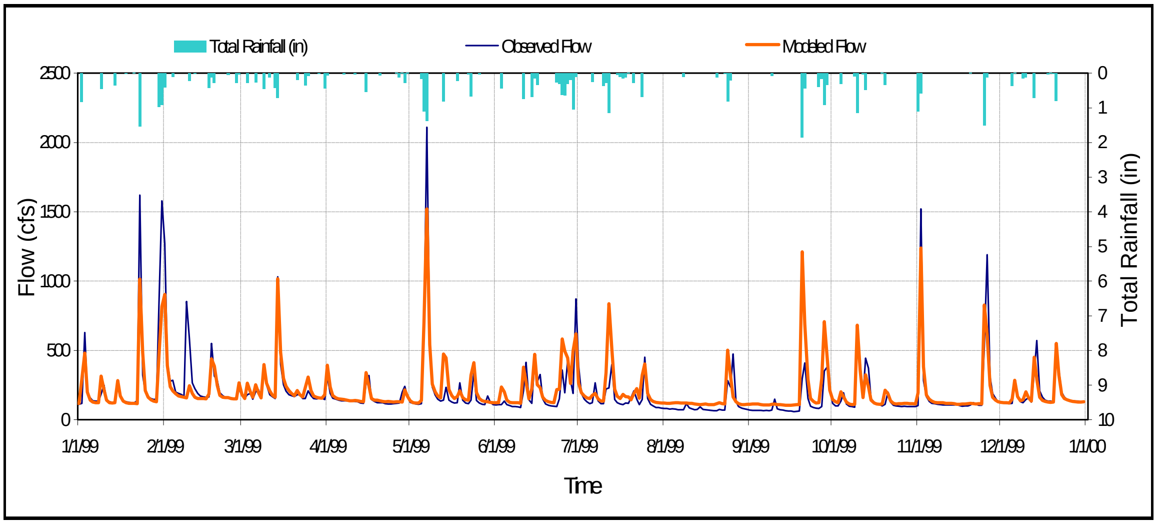


Figure A.29. Calendar Year 1999 (Daily Flow) at 02204070 – South River at Klondike Road.

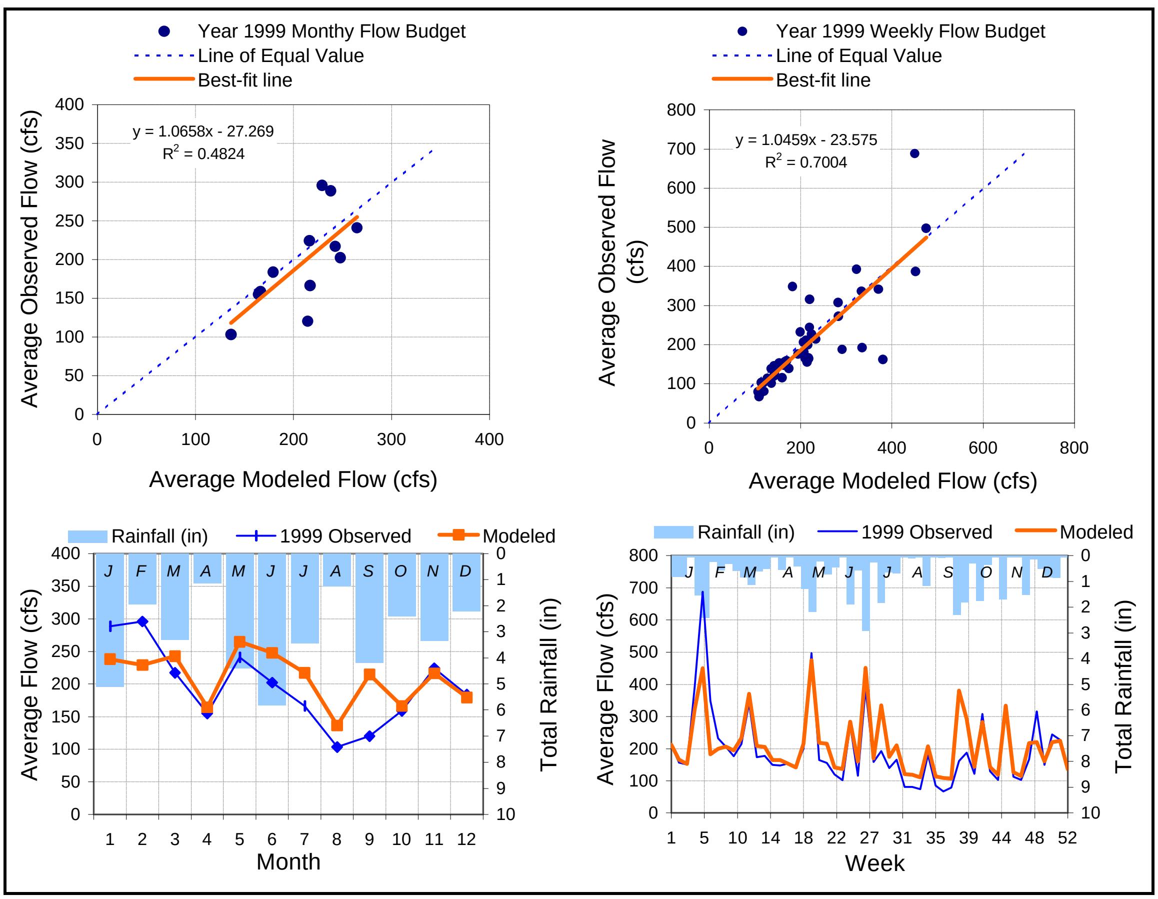


Figure A.30. Calendar Year 1999 (Monthly and Weekly) at 02204070 – South River at Klondike Road.

Simulation Name:	02204070	**Simulation Period:**	
		Watershed Area (ac):	117978
Selected a Year for Flow Analysis:	**1999**		
Type of Year (1=Calendar, 2=Water Year)	**1**	**Baseflow PERCENTILE:**	2.5
Calendar Year 1999:		*Usually 1%-5%*	
1/1/1999 to 12/31/1999			
Total Simulated In-stream Flow:	**15.43**	Total Observed In-stream Flow:	**14.41**
Total of highest 10% flows:	**4.80**	Total of Observed highest 10% flows:	**5.09**
Total of lowest 50% flows:	**4.55**	Total of Observed Lowest 50% flows:	**3.79**
Simulated Summer Flow Volume (months 7-9):	**3.51**	Observed Summer Flow Volume (7-9):	**2.41**
Simulated Fall Flow Volume (months 10-12):	**3.47**	Observed Fall Flow Volume (10-12):	**3.50**
Simulated Winter Flow Volume (months 1-3):	**4.30**	Observed Winter Flow Volume (1-3):	**4.83**
Simulated Spring Flow Volume (months 4-6):	**4.15**	Observed Spring Flow Volume (4-6):	**3.67**
Total Simulated Storm Volume:	**7.54**	Total Observed Storm Volume:	**9.61**
Simulated Summer Storm Volume (7-9):	**1.52**	Observed Summer Storm Volume (7-9):	**1.21**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**6.63**	10	
Error in 50% lowest flows:	**16.82**	10	
Error in 10% highest flows:	**-6.11**	15	
Seasonal volume error - Summer:	**31.30**	30	
Seasonal volume error - Fall:	**-0.75**	30	
Seasonal volume error - Winter:	**-12.36**	30	
Seasonal volume error - Spring:	**11.63**	30	
Error in storm volumes:	**-27.51**	20	
Error in summer storm volumes:	**20.76**	50	

Figure A.31. Calendar Year 1999 Statistics at 02204070 – South River at Klondike Road.

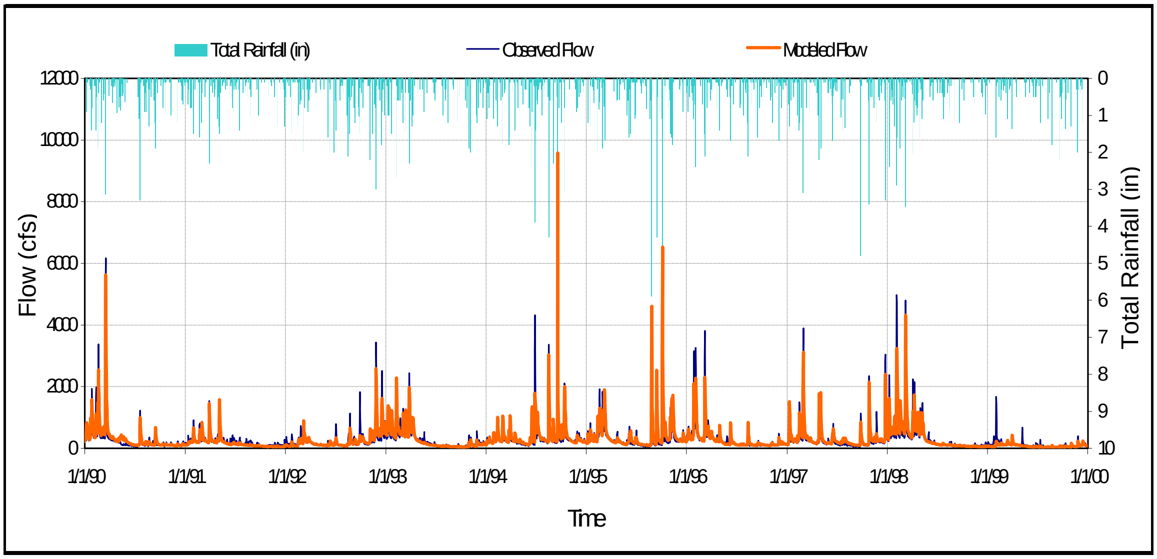


Figure A.32. 10-Year Validation (Daily Flow) at 02219000 – Apalachee River near Bostwick, GA.

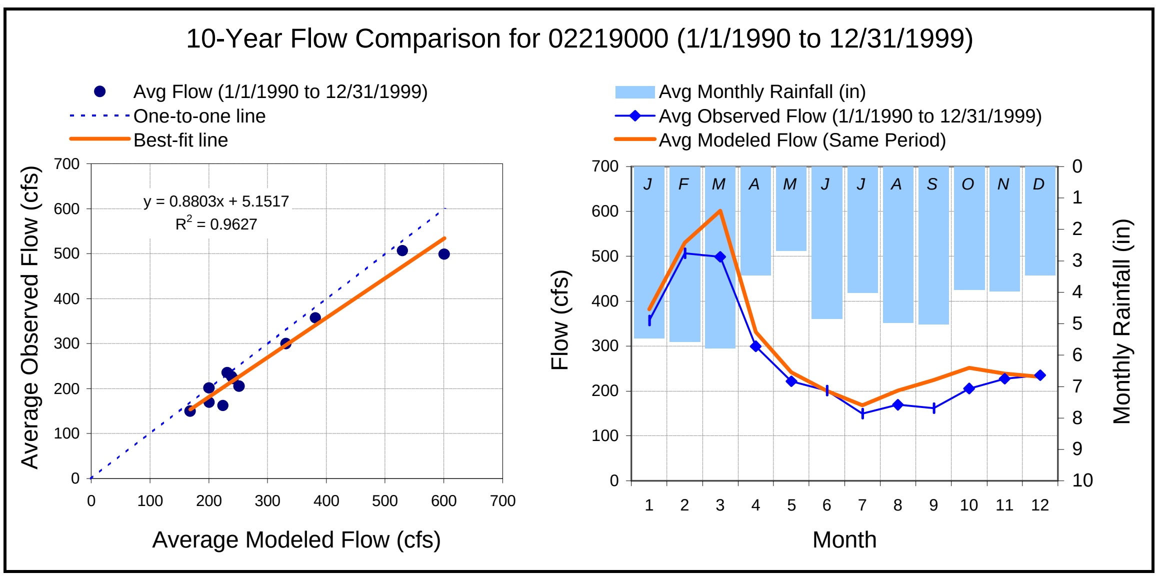


Figure A.33. 10-Year Validation (Monthly Average) at 02219000 – Apalachee River near Bostwick, GA.

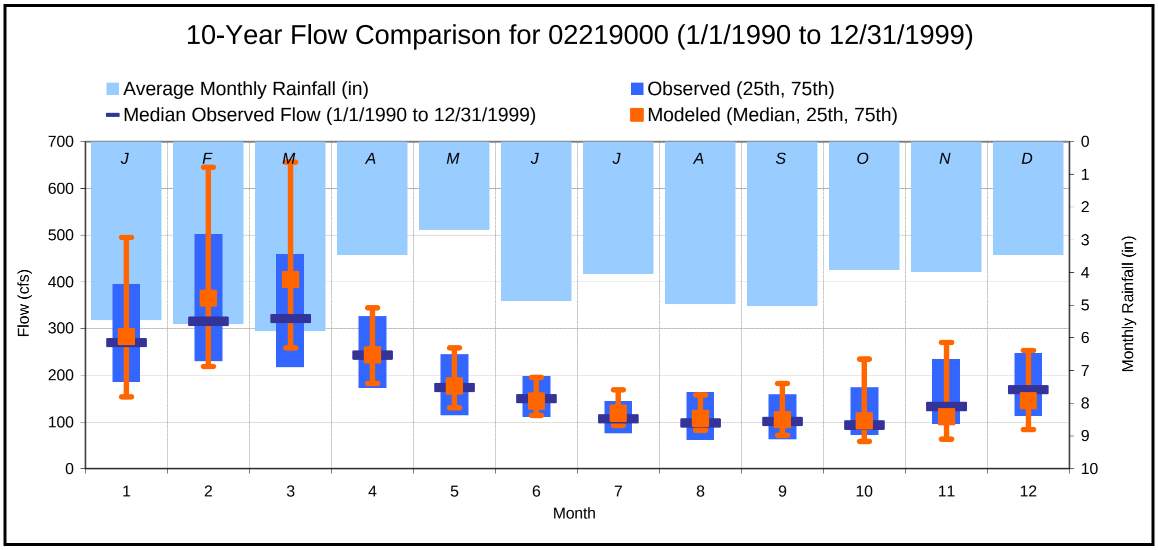


Figure A.34. 10-Year Validation (Monthly Medians) at 02219000 – Apalachee River near Bostwick, GA.

Simulation Name:	02219000	**Simulation Period:**	
		Watershed Area (ac):	119738
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**217.08**	Total Observed In-stream Flow:	**194.66**
Total of highest 10% flows:	**90.29**	Total of Observed highest 10% flows:	**78.55**
Total of lowest 50% flows:	**35.38**	Total of Observed Lowest 50% flows:	**37.57**
Simulated Summer Flow Volume (months 7-9):	**36.16**	Observed Summer Flow Volume (7-9):	**29.31**
Simulated Fall Flow Volume (months 10-12):	**44.03**	Observed Fall Flow Volume (10-12):	**40.69**
Simulated Winter Flow Volume (months 1-3):	**90.27**	Observed Winter Flow Volume (1-3):	**81.15**
Simulated Spring Flow Volume (months 4-6):	**46.62**	Observed Spring Flow Volume (4-6):	**43.51**
Total Simulated Storm Volume:	**185.93**	Total Observed Storm Volume:	**162.94**
Simulated Summer Storm Volume (7-9):	**28.43**	Observed Summer Storm Volume (7-9):	**21.48**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**10.33**	10	
Error in 50% lowest flows:	**-6.21**	10	
Error in 10% highest flows:	**13.01**	15	
Seasonal volume error - Summer:	**18.93**	30	
Seasonal volume error - Fall:	**7.60**	30	
Seasonal volume error - Winter:	**10.10**	30	
Seasonal volume error - Spring:	**6.66**	30	
Error in storm volumes:	**12.36**	20	
Error in summer storm volumes:	**24.43**	50	

Figure A.35. 10-Year Validation Statistics at 02219000 – Apalachee River near Bostwick, GA.

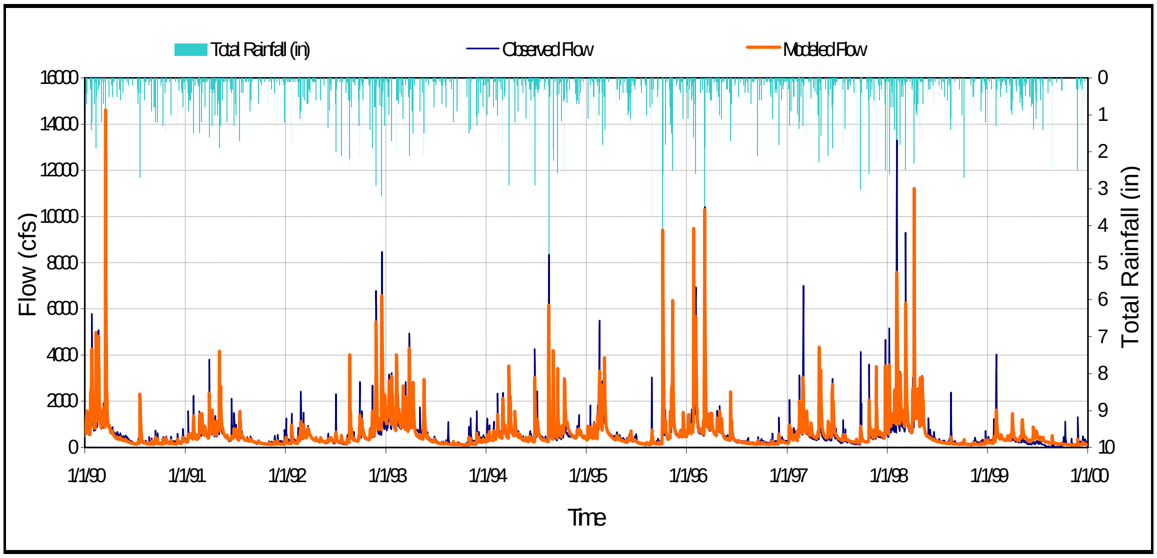


Figure A.36. 10-Year Validation (Daily Flow) at 02217500 – Middle Oconee River near Athens, GA.

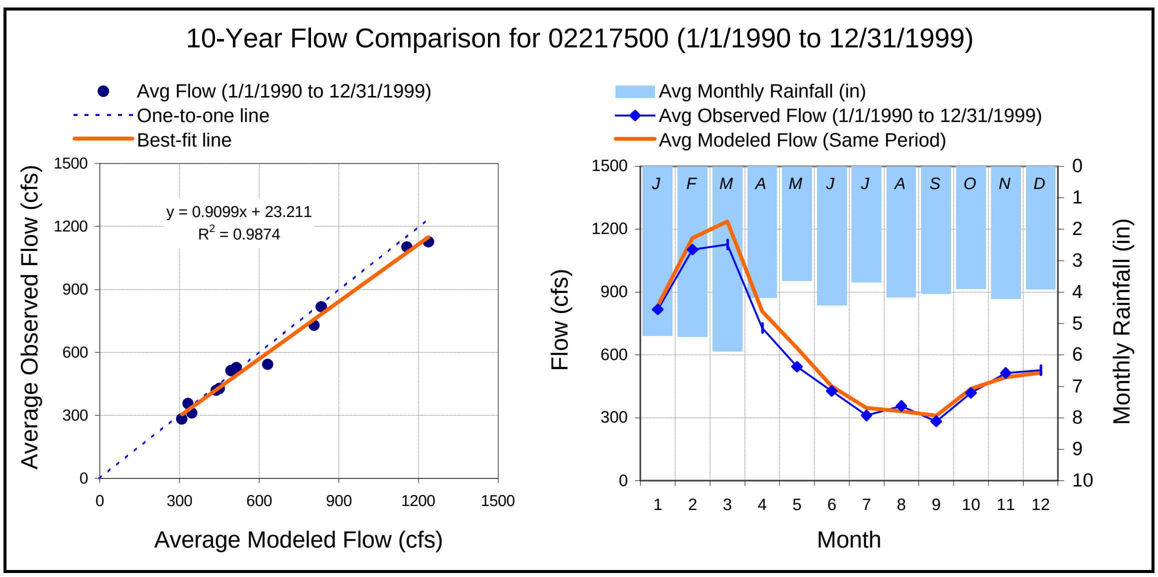


Figure A.37. 10-Year Validation (Monthly Average) at 02217500 – Middle Oconee River near Athens, GA.

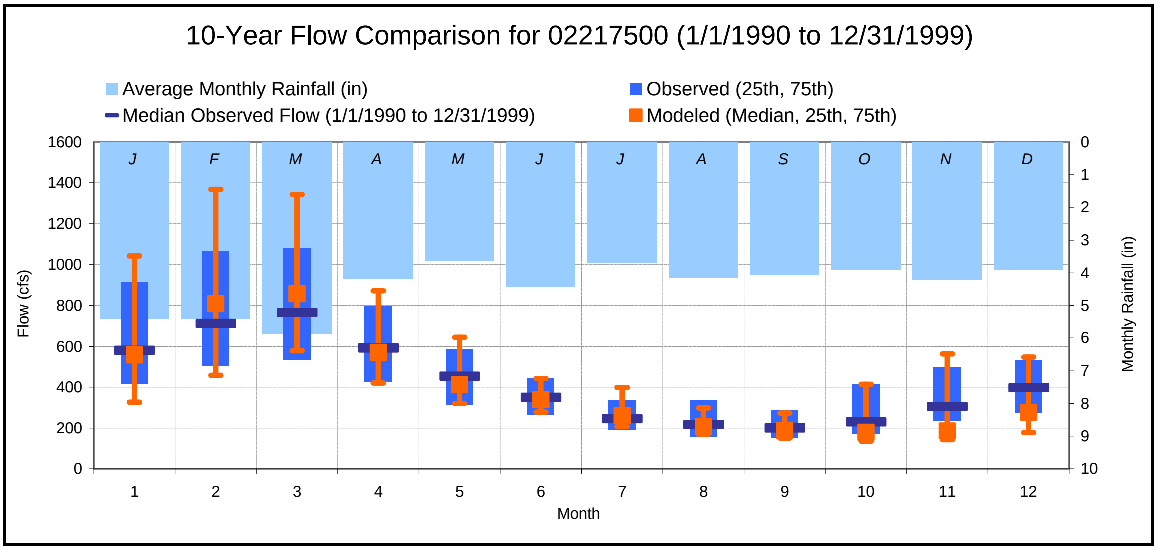


Figure A.38. 10-Year Validation (Monthly Medians) at 02217500 – Middle Oconee River near Athens, GA.

Simulation Name:	02217500	**Simulation Period:**	
		Watershed Area (ac):	252006
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**216.24**	Total Observed In-stream Flow:	**204.71**
Total of highest 10% flows:	**86.28**	Total of Observed highest 10% flows:	**78.78**
Total of lowest 50% flows:	**38.25**	Total of Observed Lowest 50% flows:	**41.80**
Simulated Summer Flow Volume (months 7-9):	**28.67**	Observed Summer Flow Volume (7-9):	**27.55**
Simulated Fall Flow Volume (months 10-12):	**41.92**	Observed Fall Flow Volume (10-12):	**42.23**
Simulated Winter Flow Volume (months 1-3):	**91.48**	Observed Winter Flow Volume (1-3):	**86.27**
Simulated Spring Flow Volume (months 4-6):	**54.17**	Observed Spring Flow Volume (4-6):	**48.65**
Total Simulated Storm Volume:	**175.96**	Total Observed Storm Volume:	**167.18**
Simulated Summer Storm Volume (7-9):	**18.50**	Observed Summer Storm Volume (7-9):	**18.39**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**5.33**	10	
Error in 50% lowest flows:	**-9.30**	10	
Error in 10% highest flows:	**8.69**	15	
Seasonal volume error - Summer:	**3.89**	30	
Seasonal volume error - Fall:	**-0.74**	30	
Seasonal volume error - Winter:	**5.69**	30	
Seasonal volume error - Spring:	**10.19**	30	
Error in storm volumes:	**4.99**	20	
Error in summer storm volumes:	**0.61**	50	

Figure A.39. 10-Year Validation Statistics at 02217500 – Middle Oconee River near Athens, GA.

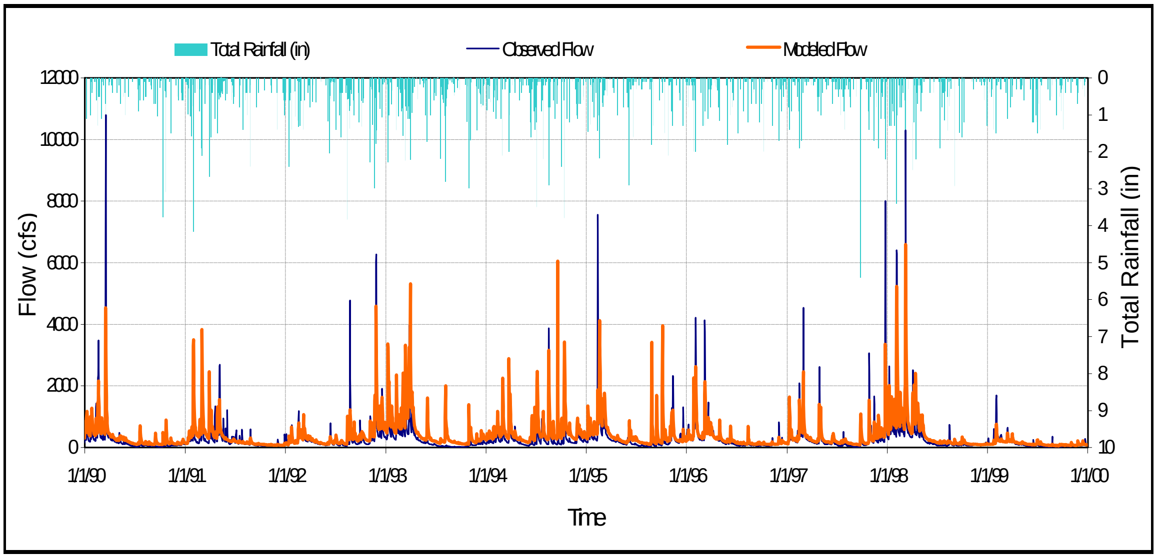


Figure A.40. 10-Year Validation (Daily Flow) at 02220900 – Little River near Eatonton, GA.

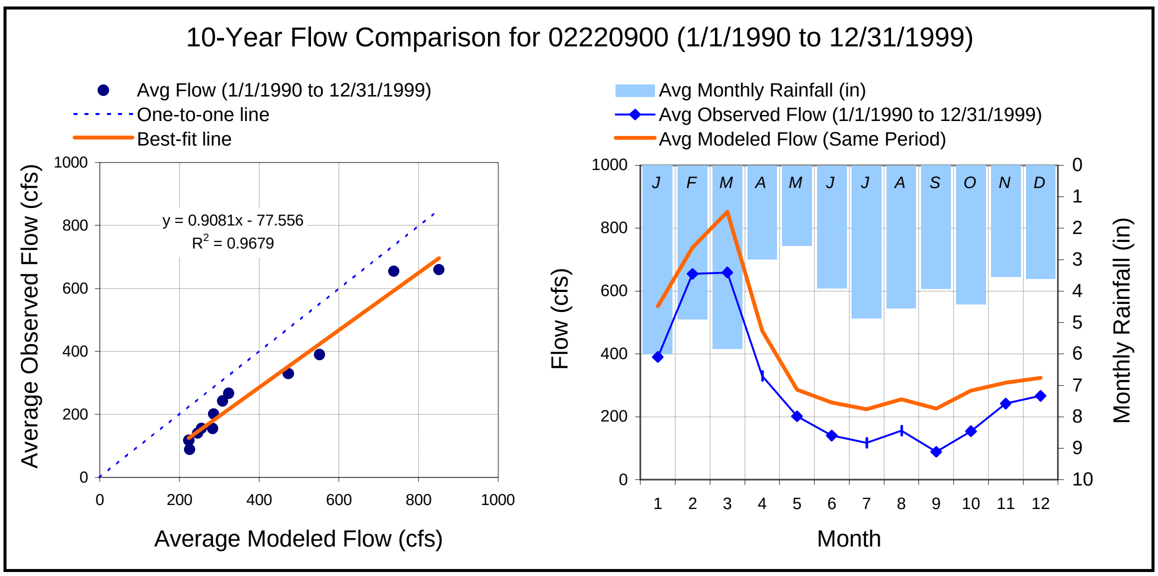


Figure A.41. 10-Year Validation (Monthly Average) at 02220900 – Little River near Eatonton, GA.

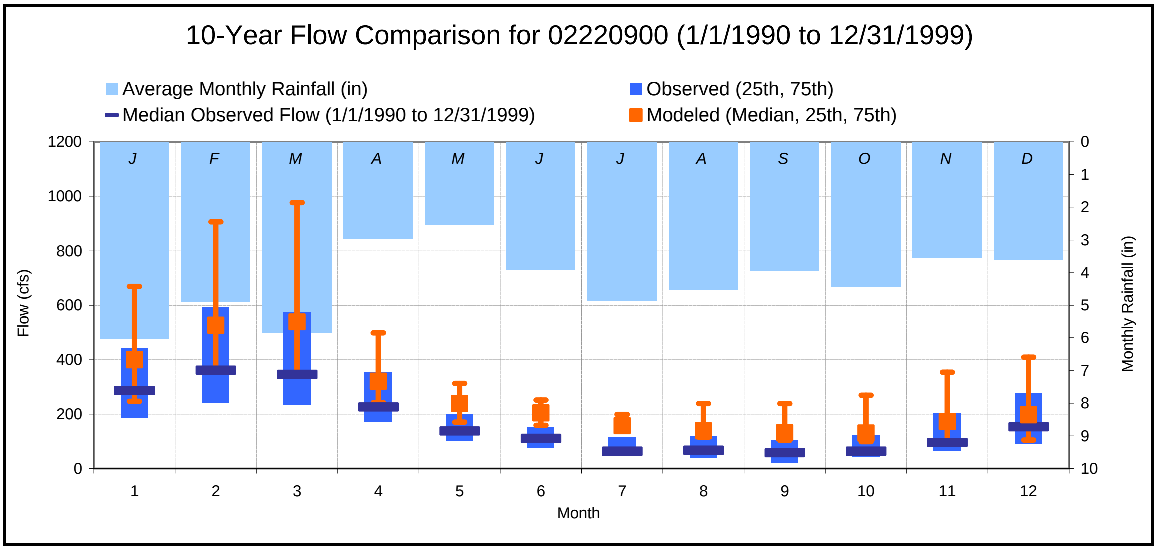


Figure A.42. 10-Year Validation (Monthly Medians) at 02220900 – Little River near Eatonton, GA.

Simulation Name:	02220900	**Simulation Period:**	
		Watershed Area (ac):	174445
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**197.17**	Total Observed In-stream Flow:	**140.21**
Total of highest 10% flows:	**77.93**	Total of Observed highest 10% flows:	**67.14**
Total of lowest 50% flows:	**34.87**	Total of Observed Lowest 50% flows:	**18.88**
Simulated Summer Flow Volume (months 7-9):	**29.53**	Observed Summer Flow Volume (7-9):	**15.17**
Simulated Fall Flow Volume (months 10-12):	**38.32**	Observed Fall Flow Volume (10-12):	**27.72**
Simulated Winter Flow Volume (months 1-3):	**87.78**	Observed Winter Flow Volume (1-3):	**69.58**
Simulated Spring Flow Volume (months 4-6):	**41.54**	Observed Spring Flow Volume (4-6):	**27.75**
Total Simulated Storm Volume:	**162.94**	Total Observed Storm Volume:	**131.80**
Simulated Summer Storm Volume (7-9):	**20.93**	Observed Summer Storm Volume (7-9):	**13.08**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**28.89**	10	
Error in 50% lowest flows:	**45.86**	10	
Error in 10% highest flows:	**13.84**	15	
Seasonal volume error - Summer:	**48.64**	30	
Seasonal volume error - Fall:	**27.66**	30	
Seasonal volume error - Winter:	**20.74**	30	
Seasonal volume error - Spring:	**33.20**	30	
Error in storm volumes:	**19.11**	20	
Error in summer storm volumes:	**37.52**	50	

Figure A.43. 10-Year Validation Statistics at 02220900 – Little River near Eatonton, GA.

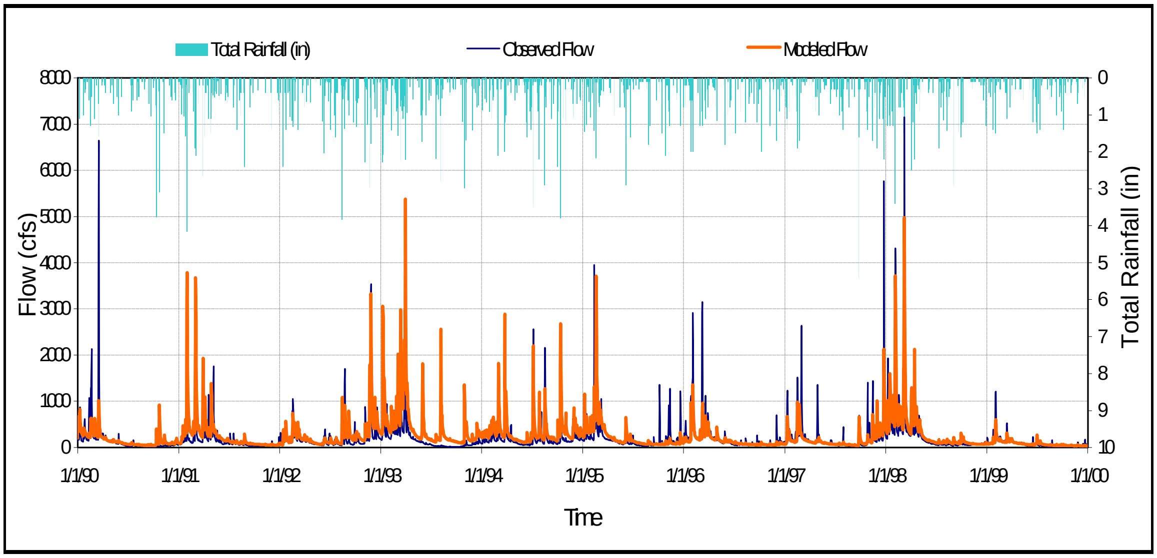


Figure A.44. 10-Year Validation (Daily Flow) at 02221525 – Murder Creek below Eatonton, GA.

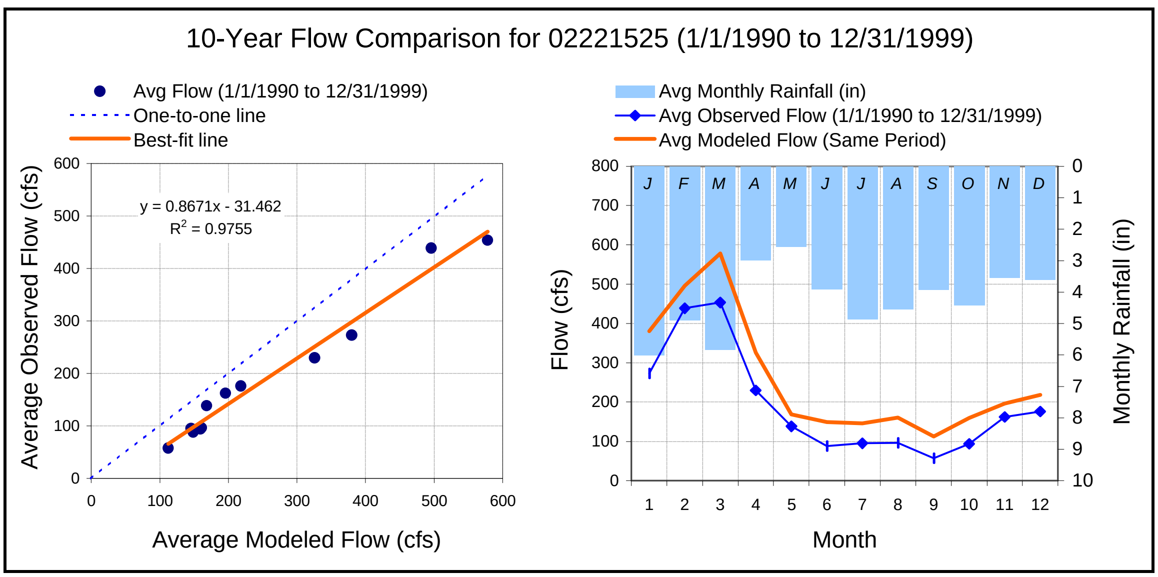


Figure A.45. 10-Year Validation (Monthly Average) at 02221525 – Murder Creek below Eatonton, GA.

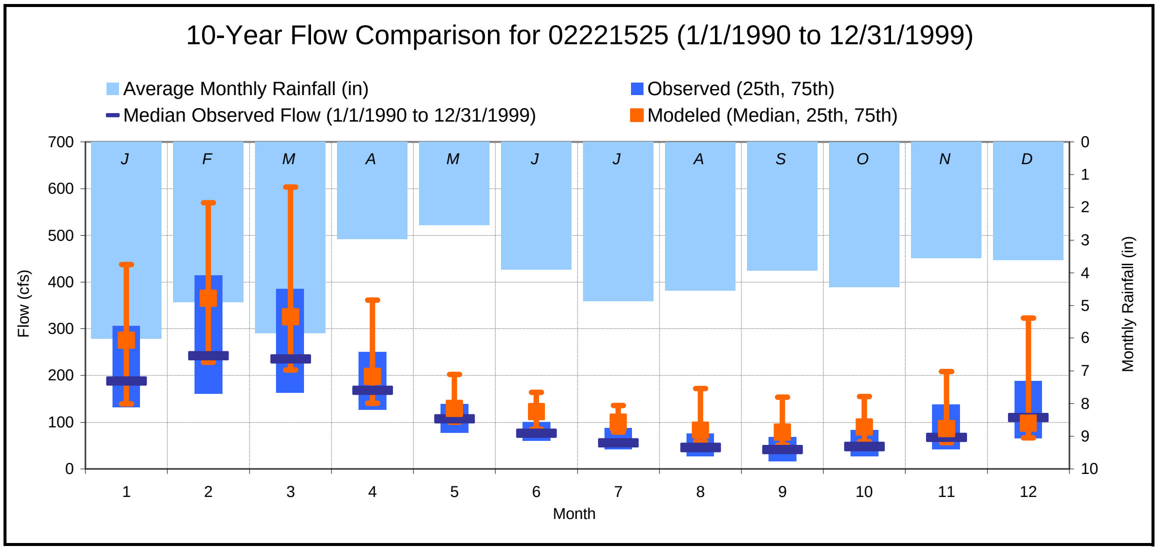


Figure A.46. 10-Year Validation (Monthly Medians) at 02221525 – Murder Creek below Eatonton, GA.

Simulation Name:	02221525	**Simulation Period:**	
		Watershed Area (ac):	121690
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**183.13**	Total Observed In-stream Flow:	**136.13**
Total of highest 10% flows:	**77.13**	Total of Observed highest 10% flows:	**65.23**
Total of lowest 50% flows:	**29.68**	Total of Observed Lowest 50% flows:	**19.42**
Simulated Summer Flow Volume (months 7-9):	**25.17**	Observed Summer Flow Volume (7-9):	**14.98**
Simulated Fall Flow Volume (months 10-12):	**34.40**	Observed Fall Flow Volume (10-12):	**25.89**
Simulated Winter Flow Volume (months 1-3):	**85.48**	Observed Winter Flow Volume (1-3):	**68.24**
Simulated Spring Flow Volume (months 4-6):	**38.09**	Observed Spring Flow Volume (4-6):	**27.02**
Total Simulated Storm Volume:	**154.89**	Total Observed Storm Volume:	**126.19**
Simulated Summer Storm Volume (7-9):	**18.04**	Observed Summer Storm Volume (7-9):	**12.51**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**25.67**	10	
Error in 50% lowest flows:	**34.59**	10	
Error in 10% highest flows:	**15.43**	15	
Seasonal volume error - Summer:	**40.47**	30	
Seasonal volume error - Fall:	**24.73**	30	
Seasonal volume error - Winter:	**20.17**	30	
Seasonal volume error - Spring:	**29.06**	30	
Error in storm volumes:	**18.52**	20	
Error in summer storm volumes:	**30.66**	50	

Figure A.47. 10-Year Validation Statistics at 02221525 – Murder Creek below Eatonton, GA.

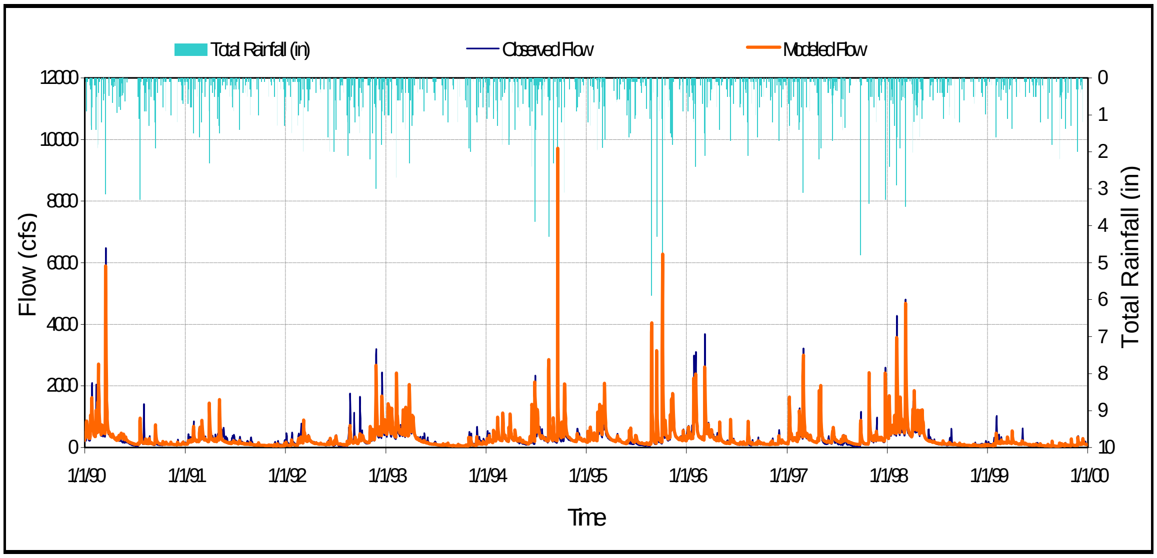


Figure A.48. 10-Year Validation (Daily Flow) at 02208450 – Alcovy River above Covington, GA.

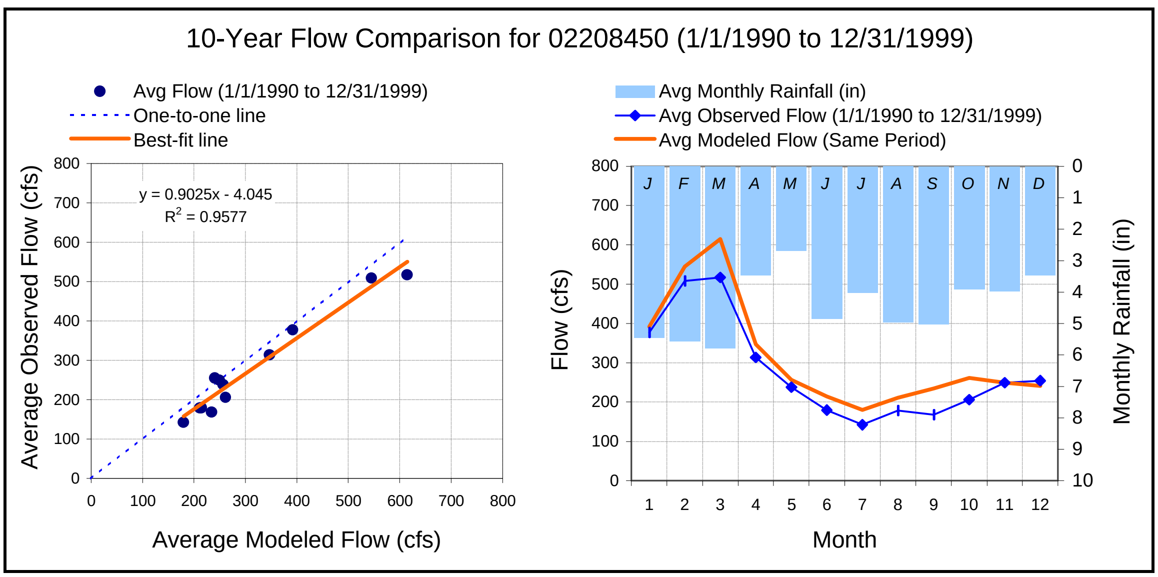


Figure A.49. 10-Year Validation (Monthly Average) at 02208450 – Alcovy River above Covington, GA.

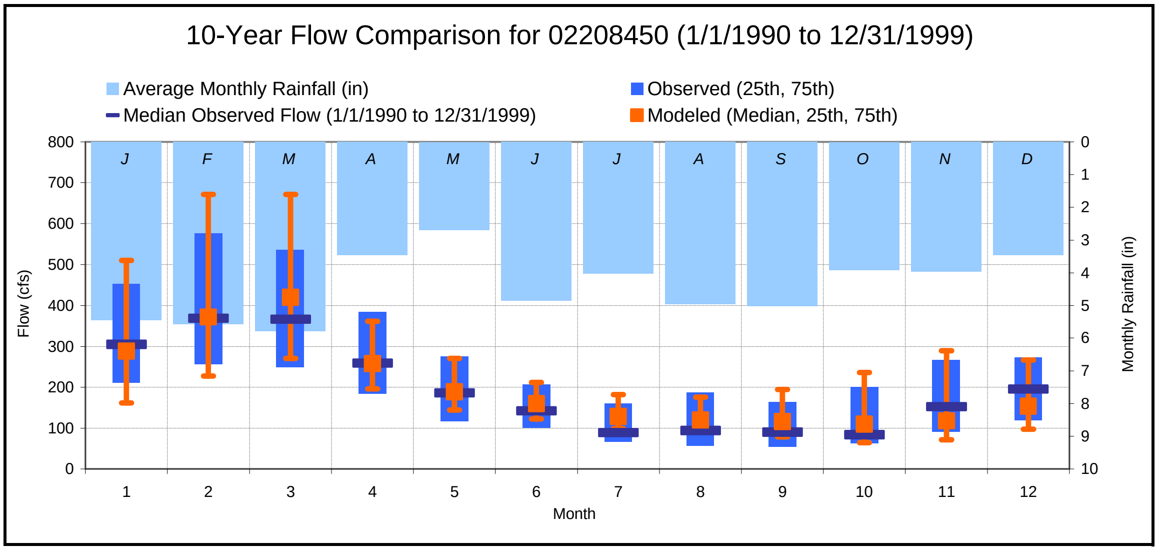


Figure A.50. 10-Year Validation (Monthly Medians) at 02208450 – Alcovy River above Covington, GA.

Simulation Name:	02208450	**Simulation Period:**	
		Watershed Area (ac):	122720
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**220.25**	Total Observed In-stream Flow:	**195.82**
Total of highest 10% flows:	**89.19**	Total of Observed highest 10% flows:	**72.34**
Total of lowest 50% flows:	**38.46**	Total of Observed Lowest 50% flows:	**35.50**
Simulated Summer Flow Volume (months 7-9):	**37.13**	Observed Summer Flow Volume (7-9):	**29.05**
Simulated Fall Flow Volume (months 10-12):	**44.68**	Observed Fall Flow Volume (10-12):	**42.19**
Simulated Winter Flow Volume (months 1-3):	**90.33**	Observed Winter Flow Volume (1-3):	**81.59**
Simulated Spring Flow Volume (months 4-6):	**48.11**	Observed Spring Flow Volume (4-6):	**42.99**
Total Simulated Storm Volume:	**184.55**	Total Observed Storm Volume:	**171.05**
Simulated Summer Storm Volume (7-9):	**28.18**	Observed Summer Storm Volume (7-9):	**22.97**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**11.09**	10	
Error in 50% lowest flows:	**7.69**	10	
Error in 10% highest flows:	**18.90**	15	
Seasonal volume error - Summer:	**21.75**	30	
Seasonal volume error - Fall:	**5.57**	30	
Seasonal volume error - Winter:	**9.68**	30	
Seasonal volume error - Spring:	**10.64**	30	
Error in storm volumes:	**7.31**	20	
Error in summer storm volumes:	**18.49**	50	

Figure A.51. 10-Year Validation Statistics at 02208450 – Alcovy River above Covington, GA.

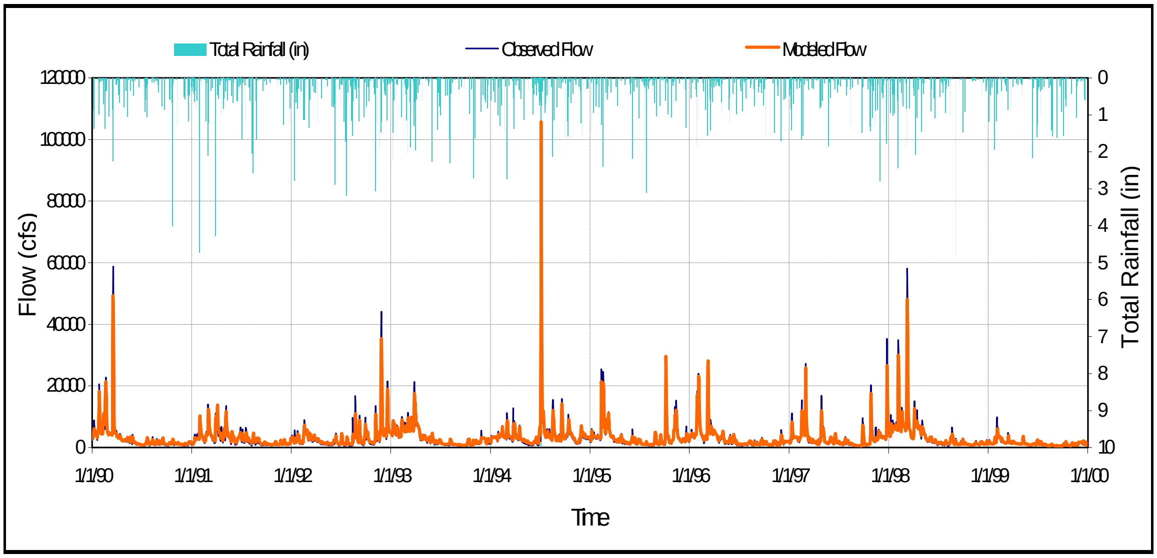


Figure A.52. 10-Year Validation (Daily Flow) at 02213000 – Ocmulgee River at Macon, GA.

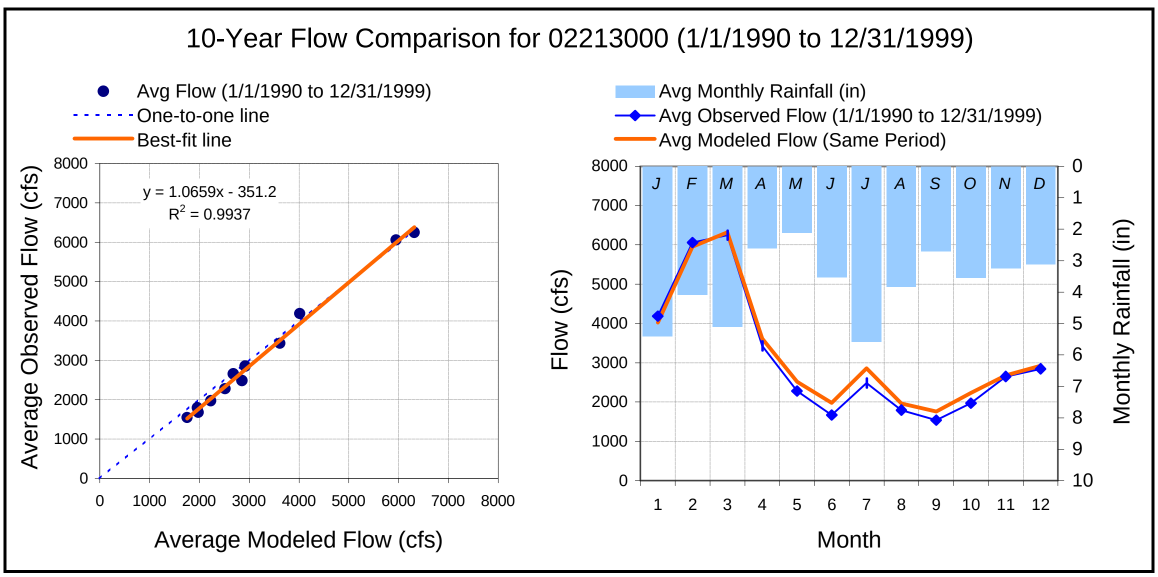


Figure A.53. 10-Year Validation (Monthly Average) at 02213000 – Ocmulgee River at Macon, GA.

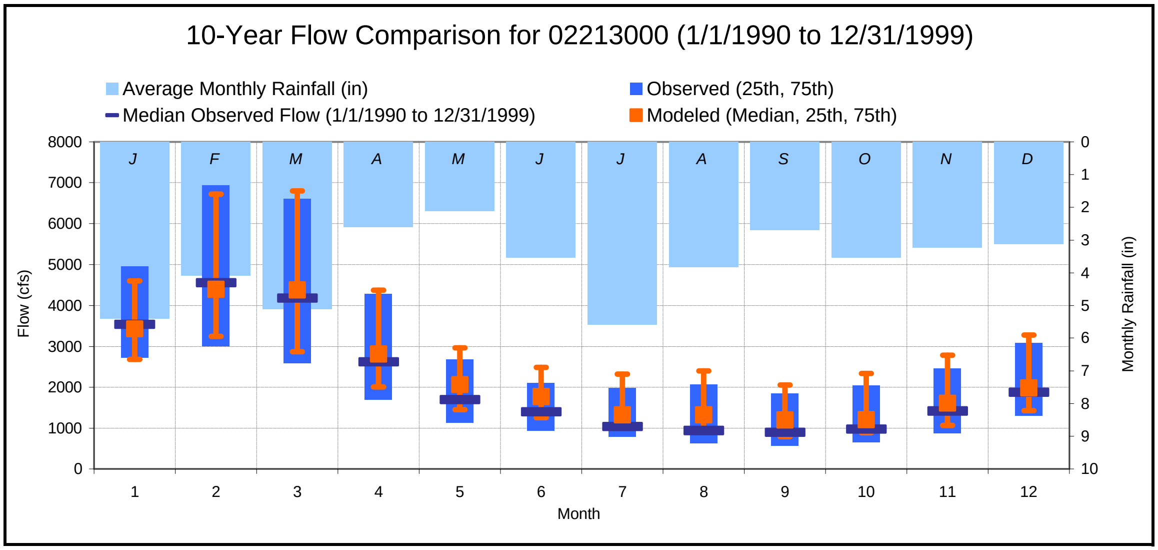


Figure A.54. 10-Year Validation (Monthly Medians) at 02213000 – Ocmulgee River at Macon, GA.

Simulation Name:	02213000	**Simulation Period:**	
		Watershed Area (ac):	1450880
Period for Flow Analysis			
Begin Date:	**01/01/90**	**Baseflow PERCENTILE:**	2.5
End Date:	**12/31/99**	*Usually 1%-5%*	
Total Simulated In-stream Flow:	**193.01**	Total Observed In-stream Flow:	**184.66**
Total of highest 10% flows:	**69.82**	Total of Observed highest 10% flows:	**72.06**
Total of lowest 50% flows:	**38.75**	Total of Observed Lowest 50% flows:	**31.13**
Simulated Summer Flow Volume (months 7-9):	**33.16**	Observed Summer Flow Volume (7-9):	**29.35**
Simulated Fall Flow Volume (months 10-12):	**39.39**	Observed Fall Flow Volume (10-12):	**37.54**
Simulated Winter Flow Volume (months 1-3):	**80.11**	Observed Winter Flow Volume (1-3):	**81.07**
Simulated Spring Flow Volume (months 4-6):	**40.35**	Observed Spring Flow Volume (4-6):	**36.70**
Total Simulated Storm Volume:	**154.66**	Total Observed Storm Volume:	**157.23**
Simulated Summer Storm Volume (7-9):	**23.59**	Observed Summer Storm Volume (7-9):	**22.55**
Errors (Simulated-Observed)		*Recommended Criteria*	Last run
Error in total volume:	**4.33**	10	
Error in 50% lowest flows:	**19.67**	10	
Error in 10% highest flows:	**-3.21**	15	
Seasonal volume error - Summer:	**11.50**	30	
Seasonal volume error - Fall:	**4.71**	30	
Seasonal volume error - Winter:	**-1.20**	30	
Seasonal volume error - Spring:	**9.03**	30	
Error in storm volumes:	**-1.66**	20	
Error in summer storm volumes:	**4.41**	50	

Figure A.55. 10-Year Validation Statistics at 02213000 – Ocmulgee River at Macon, GA.

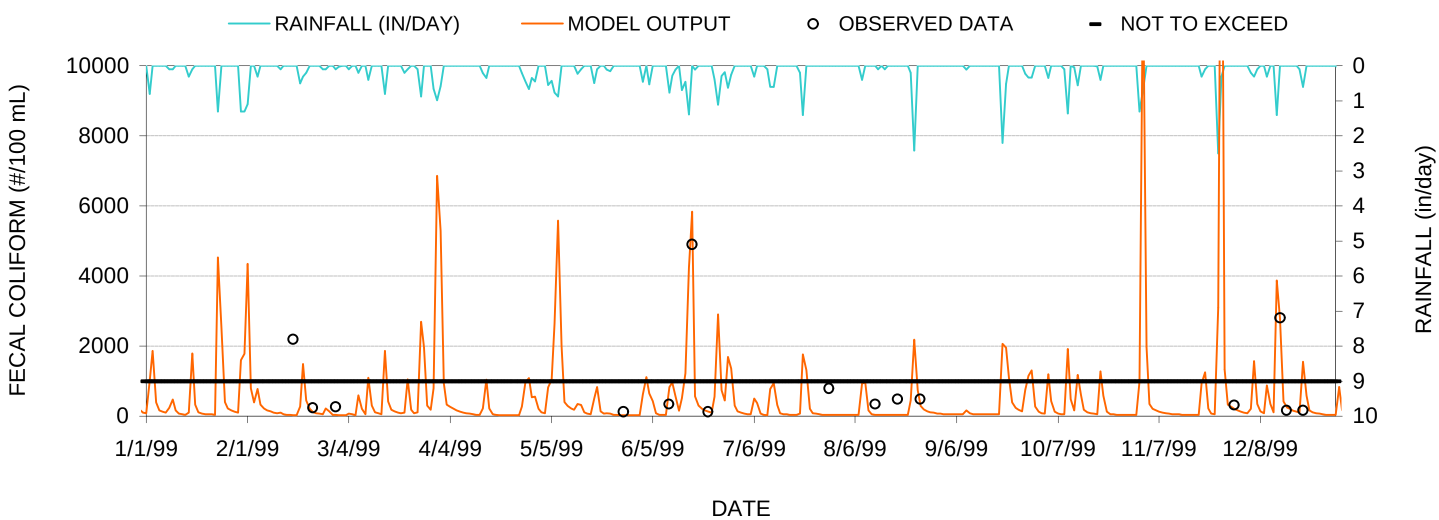
APPENDIX B:
WATER QUALITY CALIBRATION

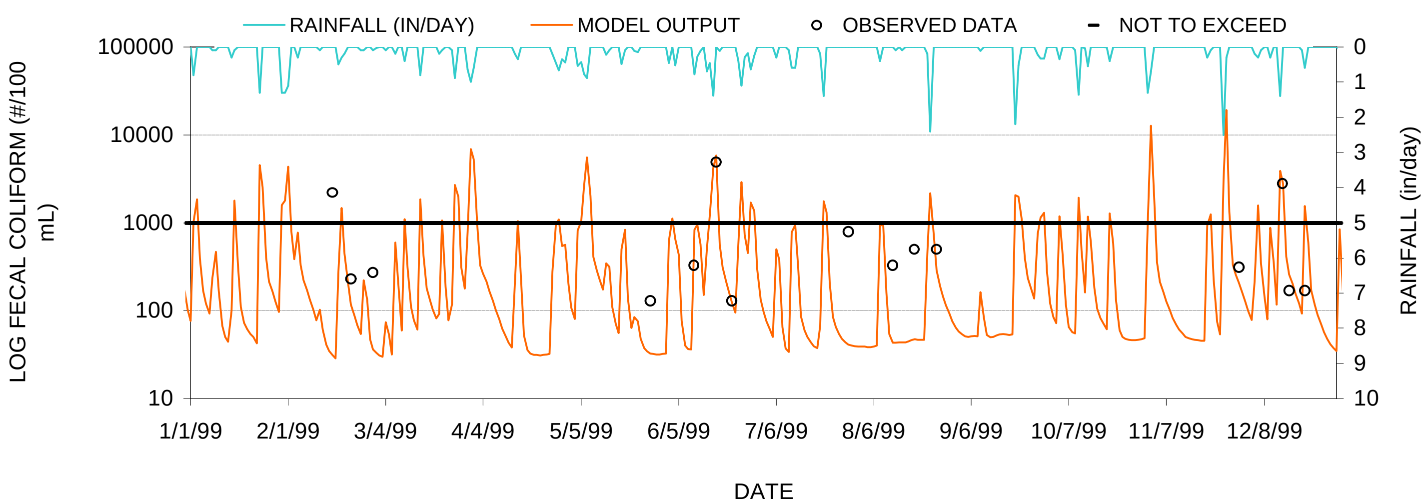
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Middle Oconee R (Mulberry R to Big Bear Cr)**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



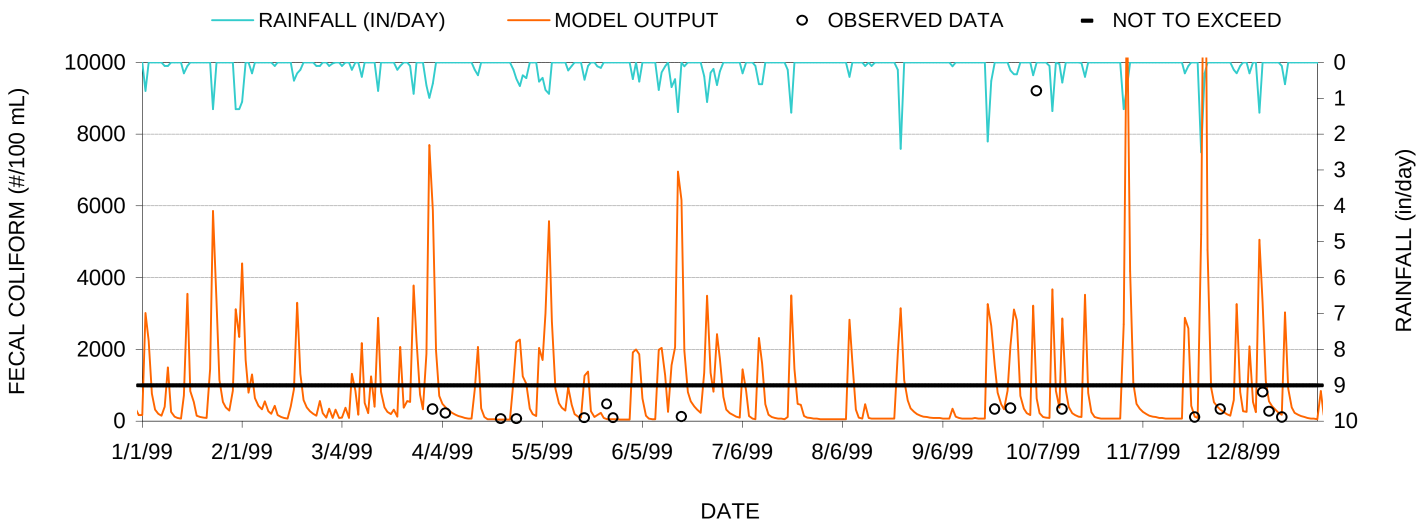


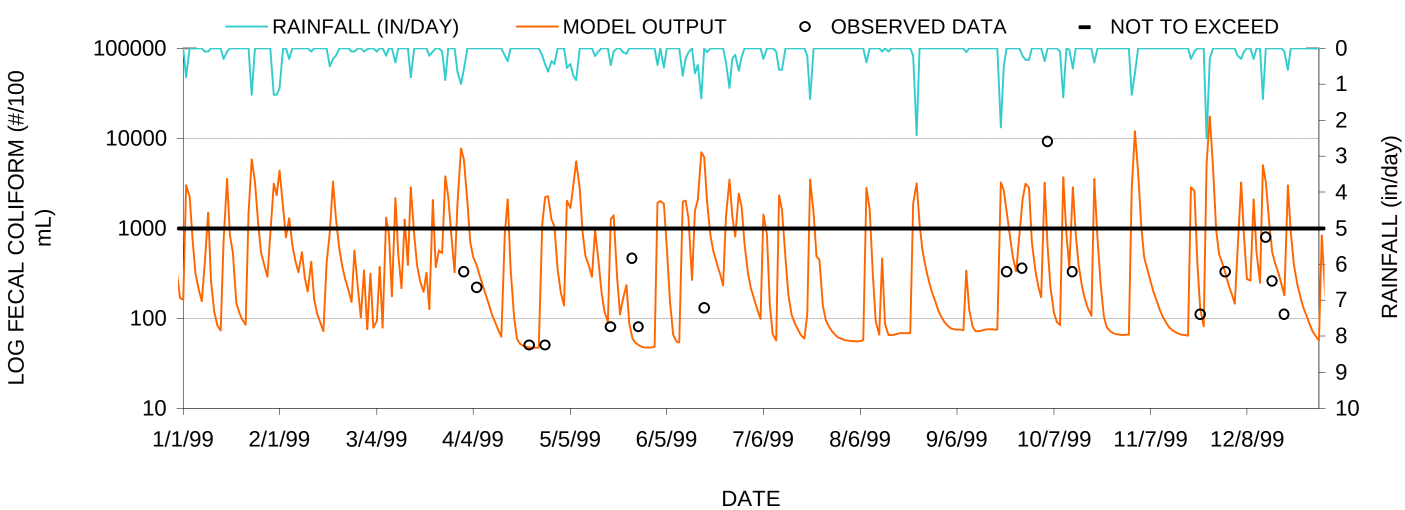
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Middle Oconee R (Big Bear Cr to McNutt Cr)**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



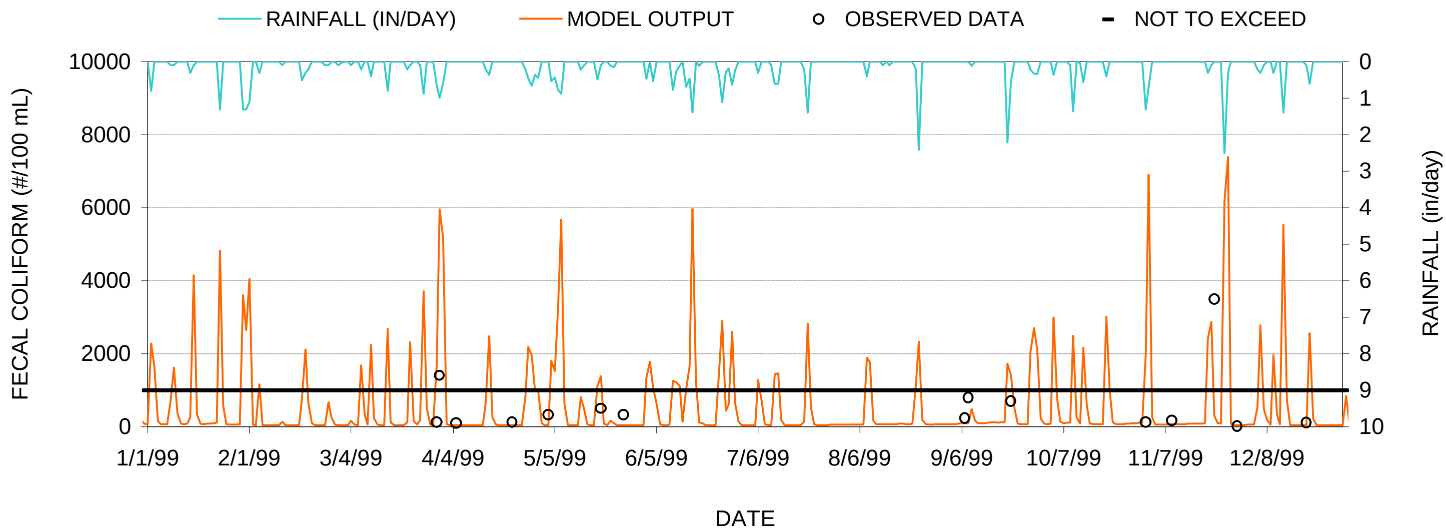


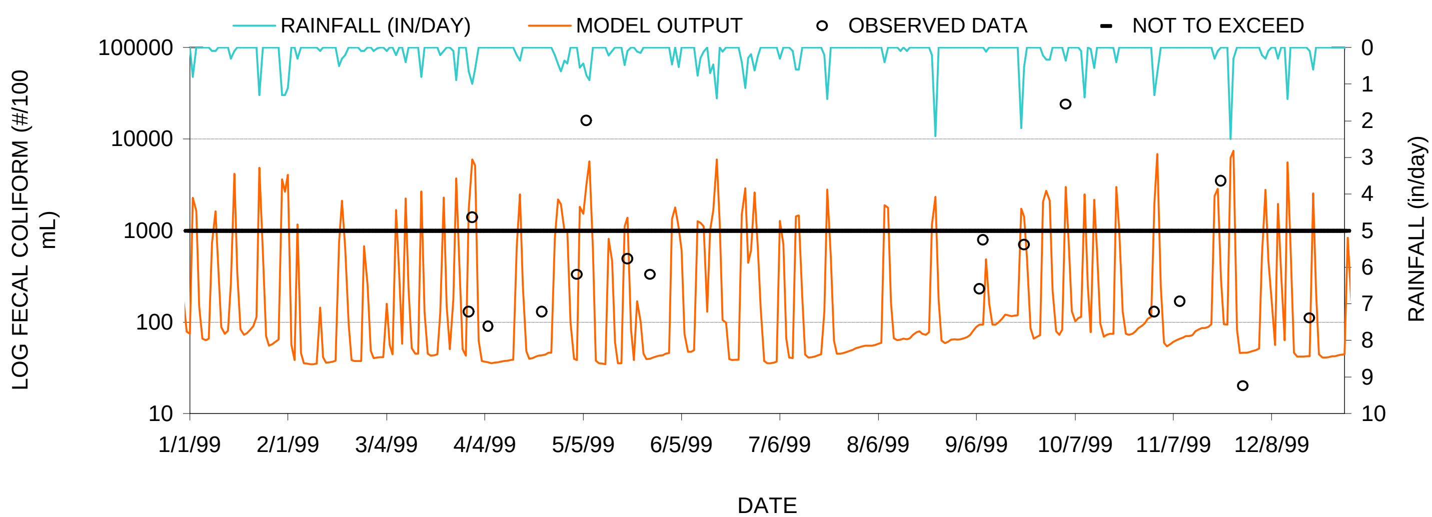
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Cedar Creek (Headwaters to Oconee R)**

MODEL RUN: 1

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



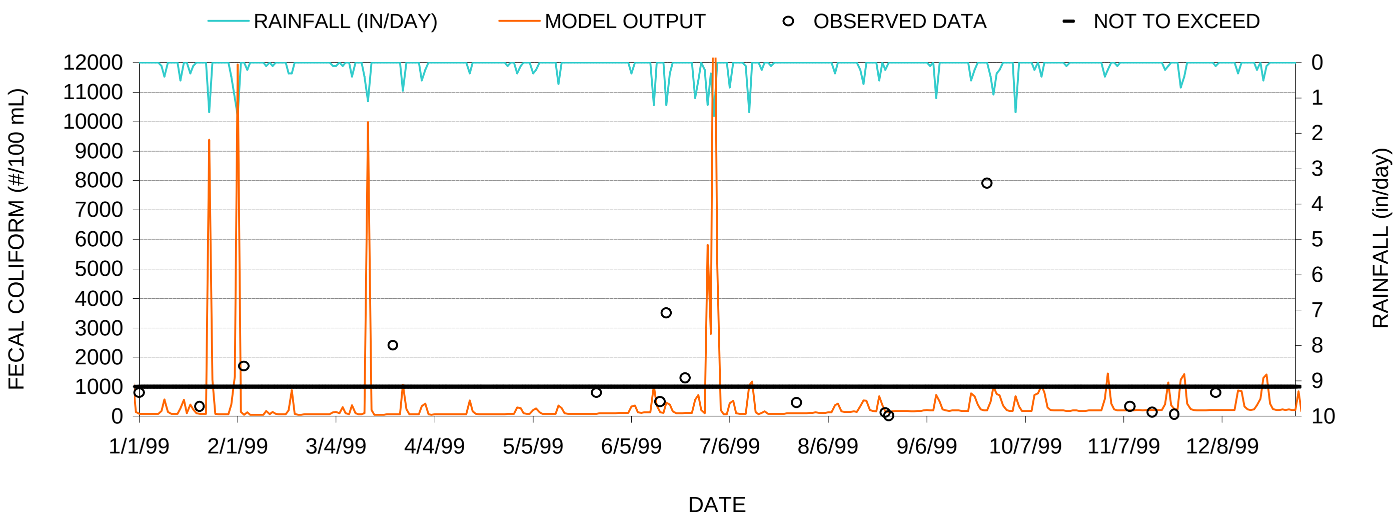


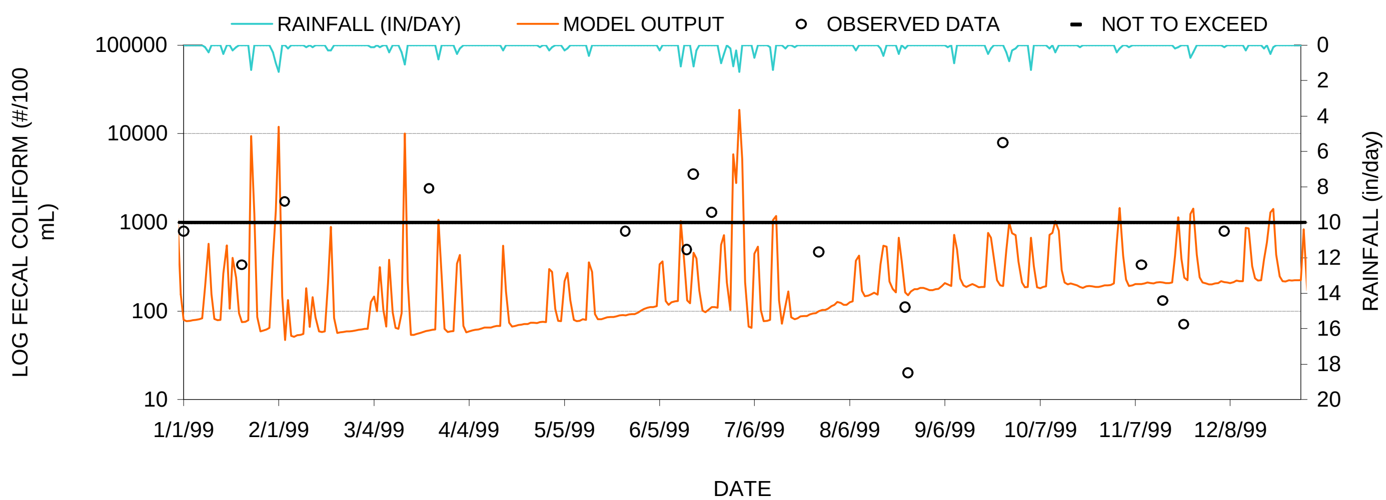
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Little Sugar Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



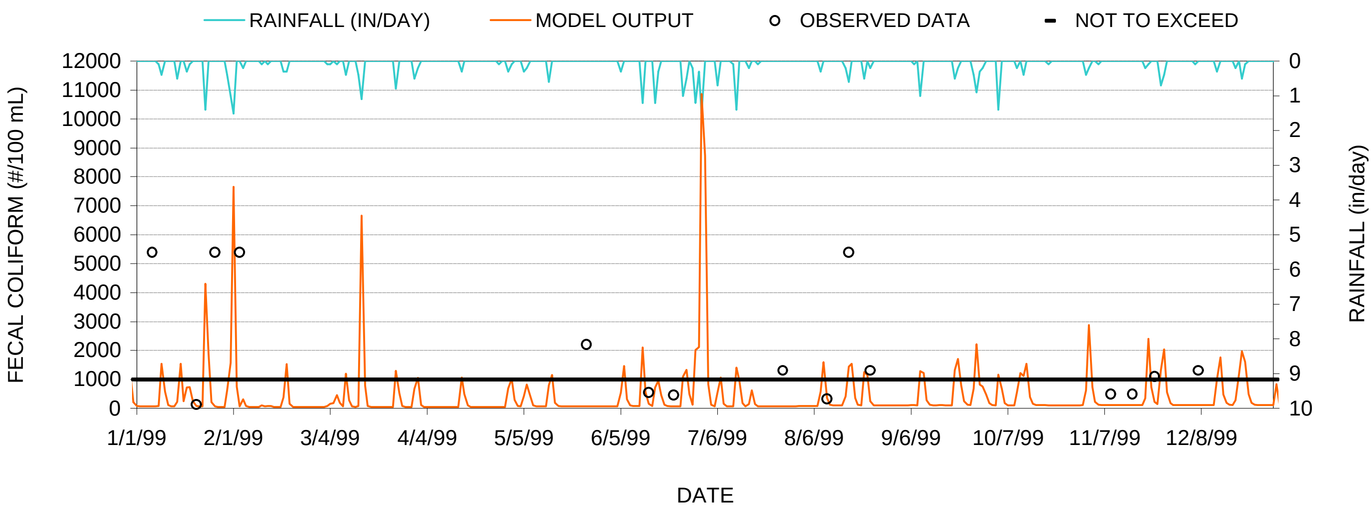


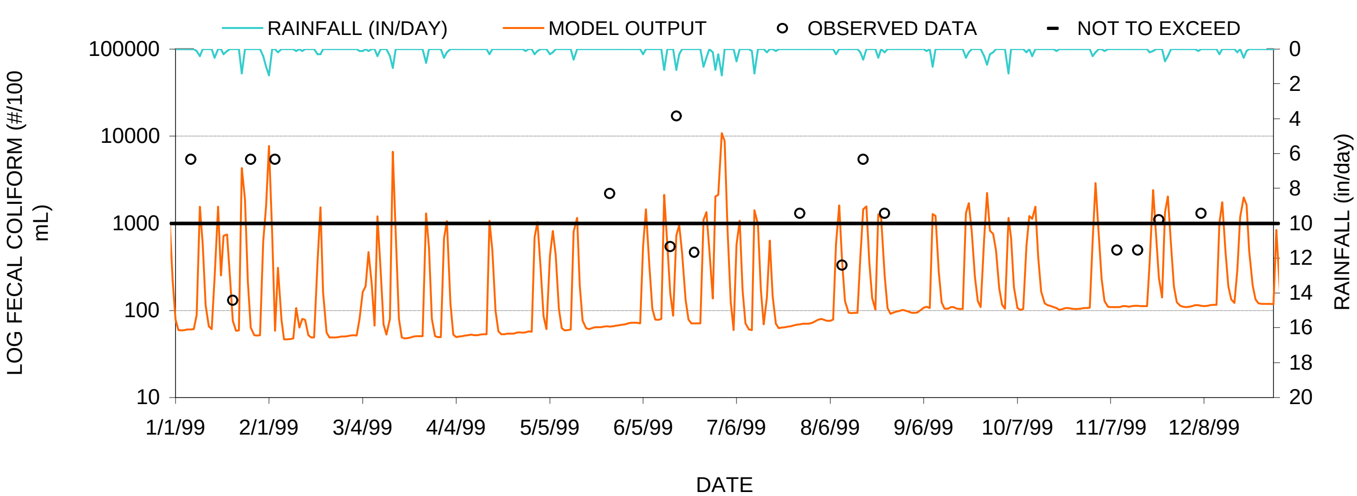
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Richland Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



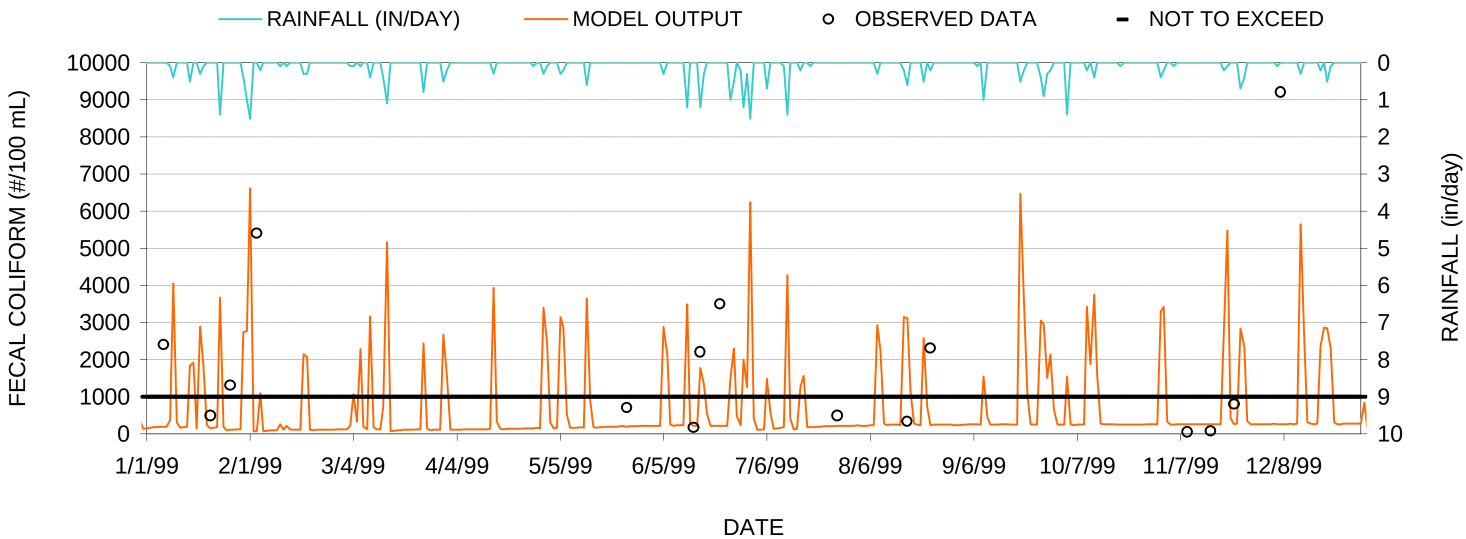


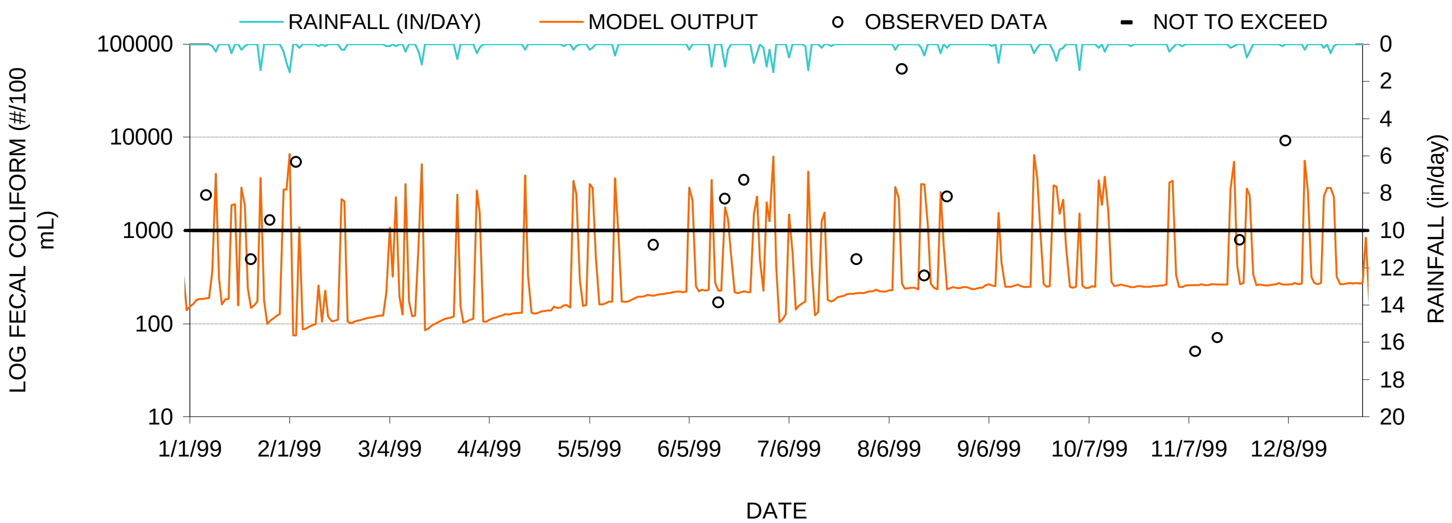
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Town Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



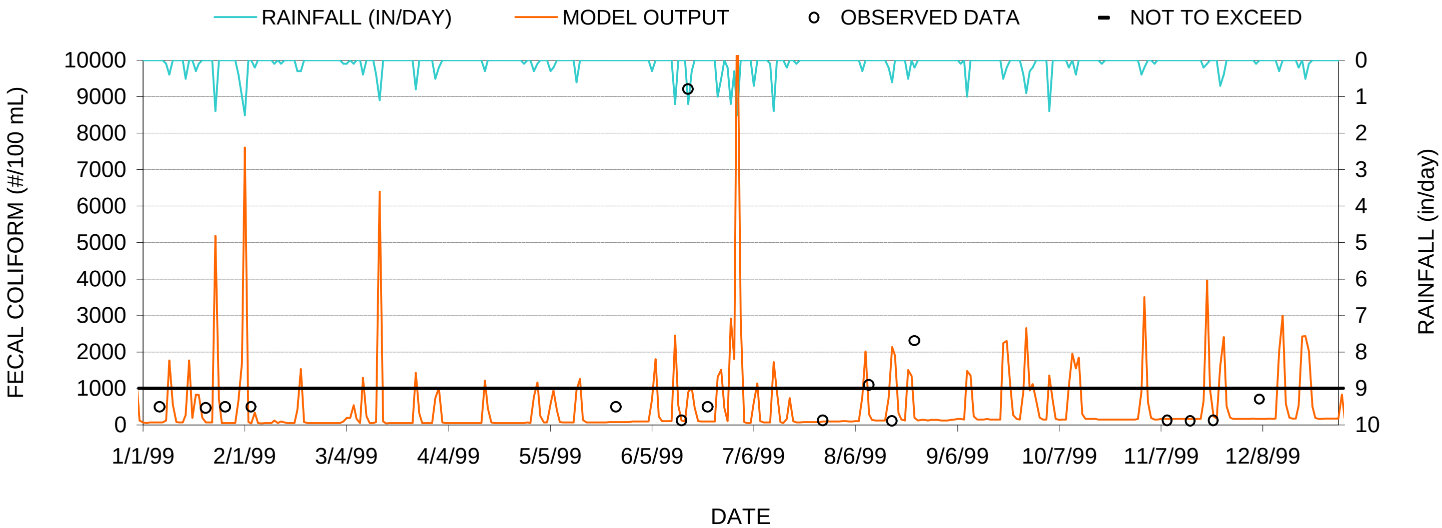


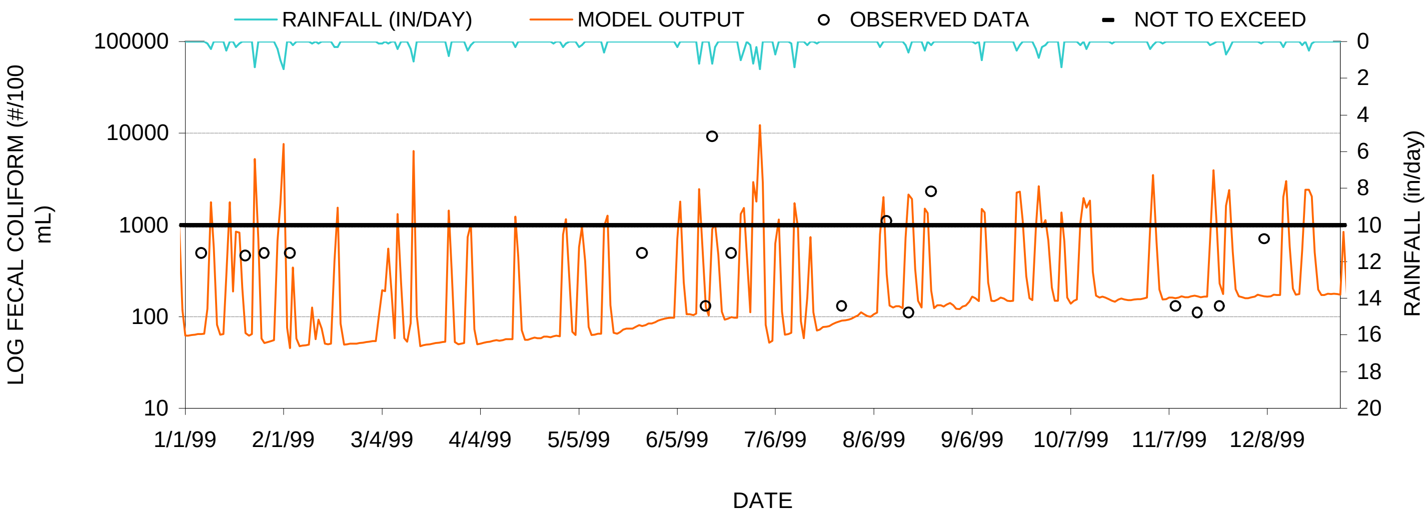
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Beaverdam Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



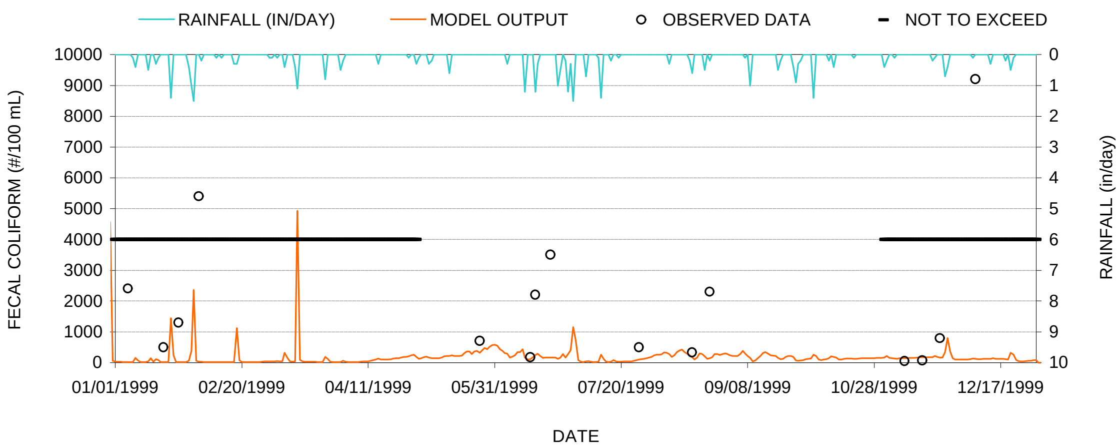


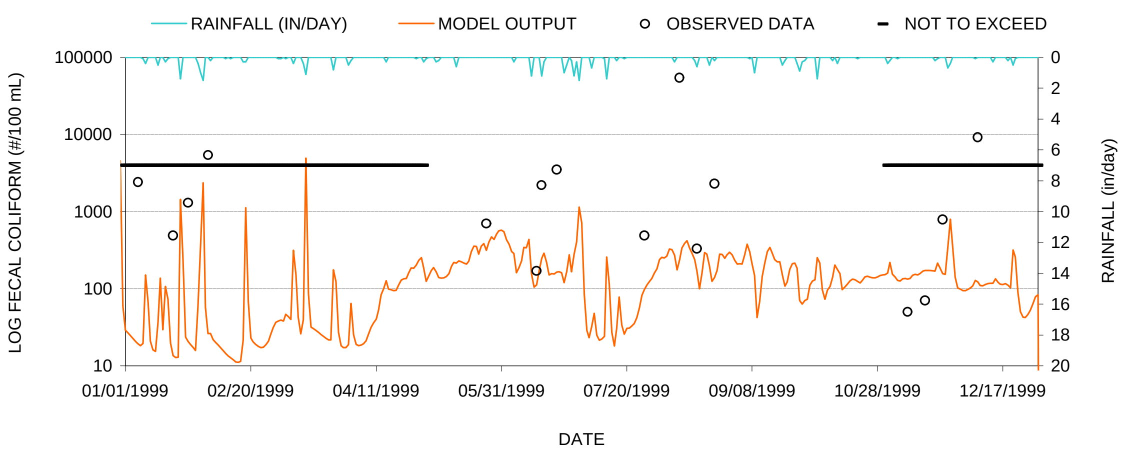
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Town Creek, Lower Oconee Basin

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



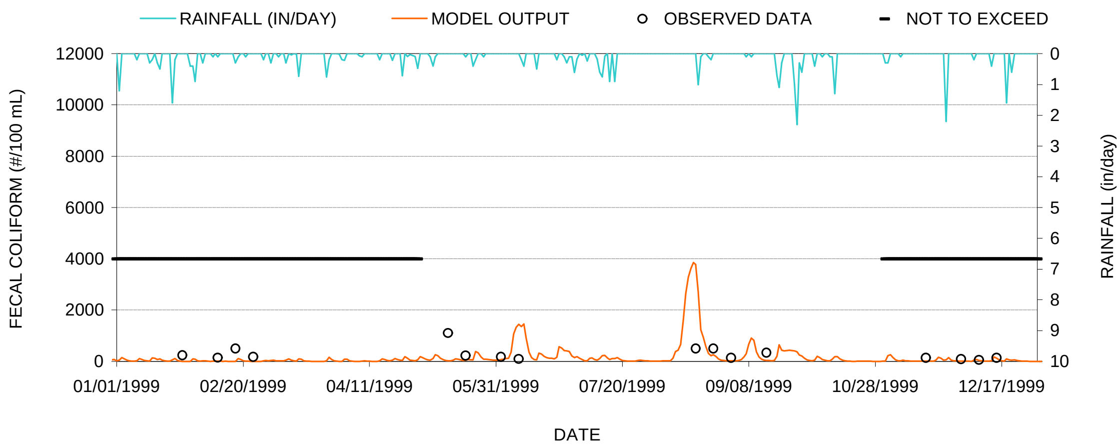


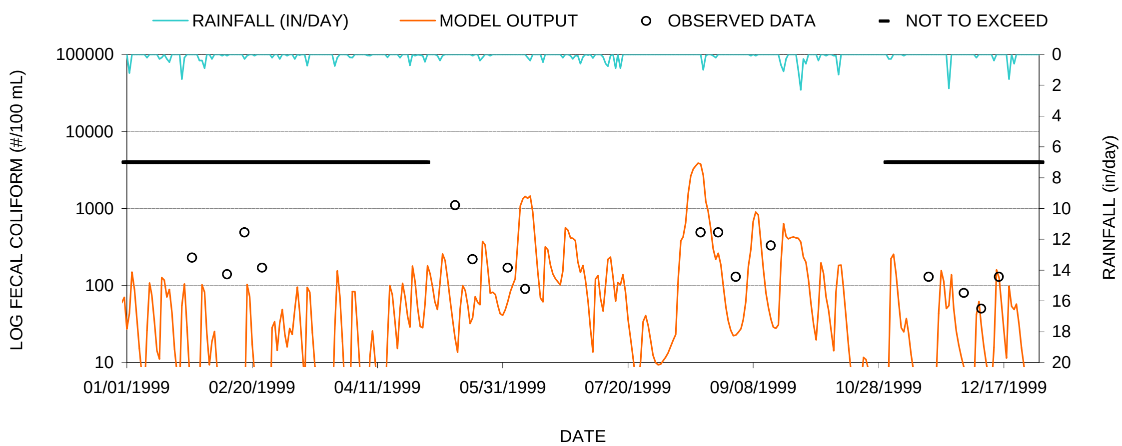
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: MODEL RUN: **1**

Big Sandy Creek, Lower Oconee Basin

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



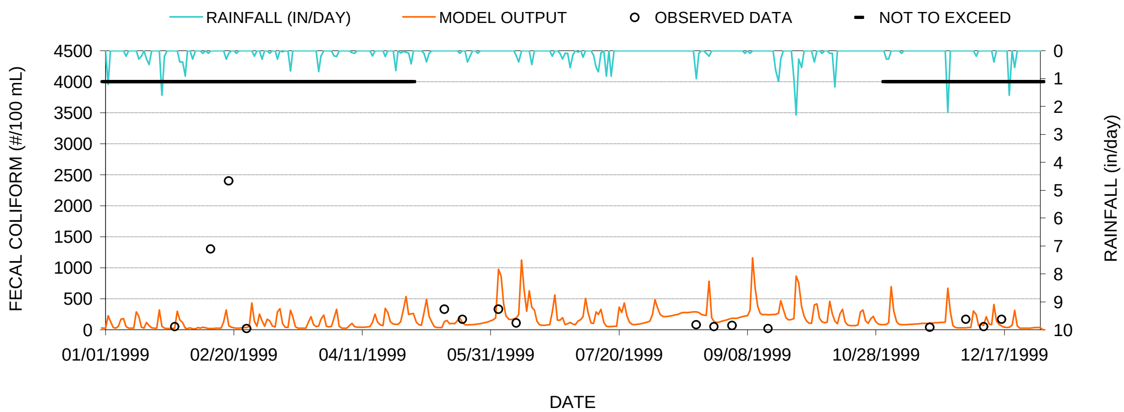


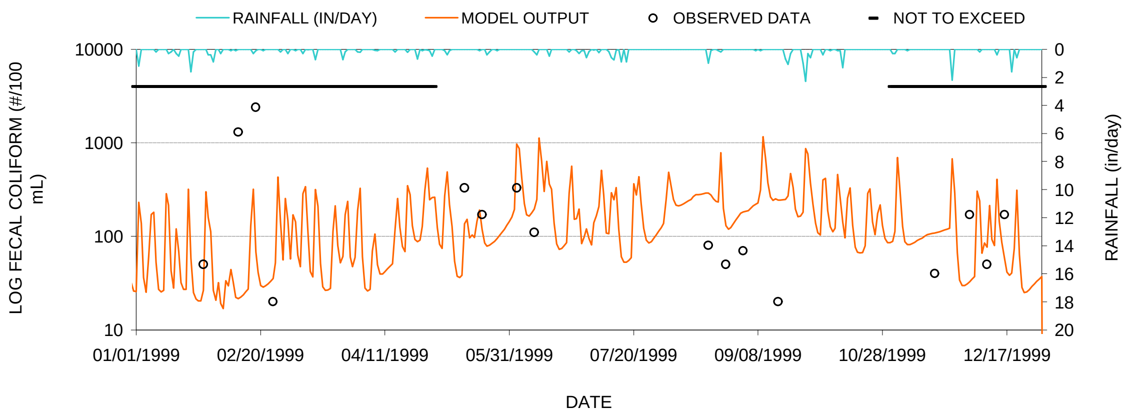
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: MODEL RUN: **1**

Oconee River, Long Branch to Turkey Creek; Lower Oconee Basin

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



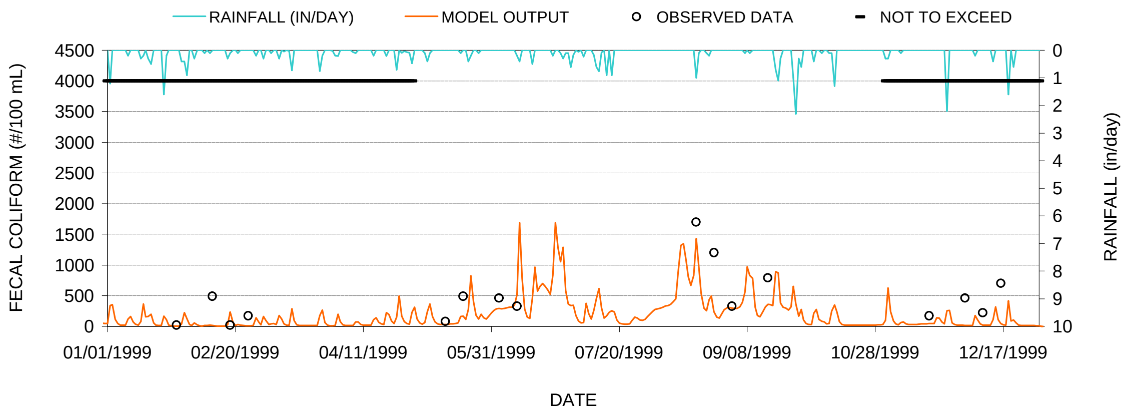


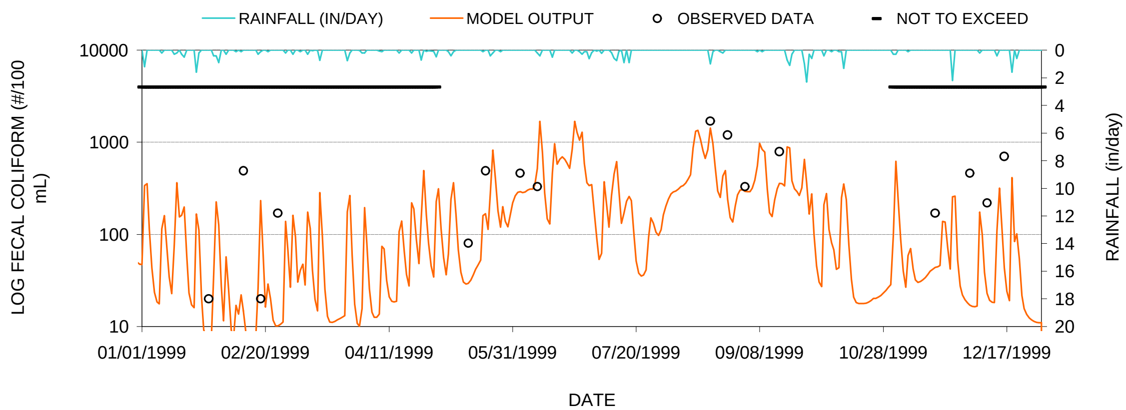
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Turkey Creek, Horse Branch to Rocky Creek; Lower Oconee Basin**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



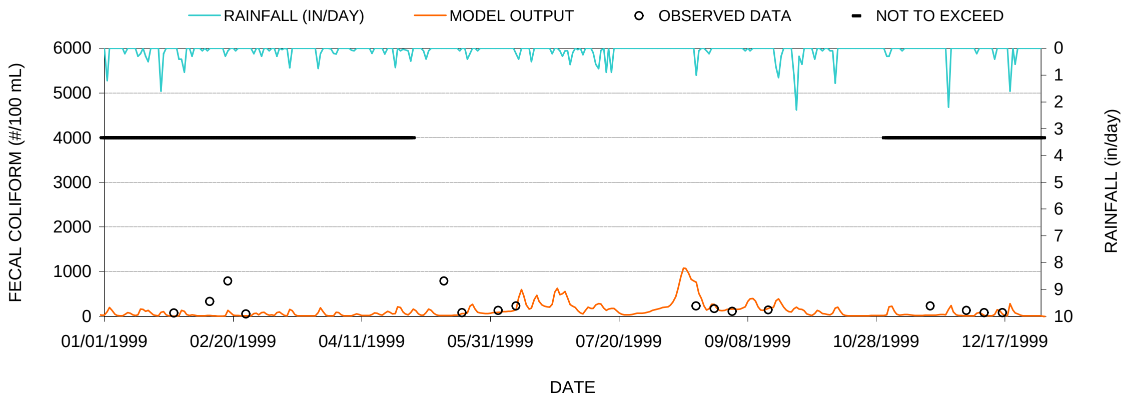


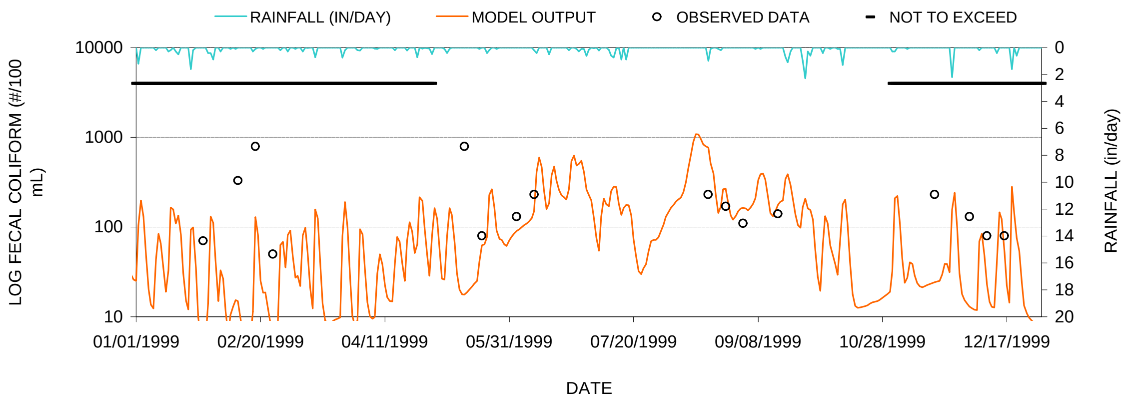
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Turkey Creek, Rocky Creek to Oconee River; Lower Oconee Basin**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



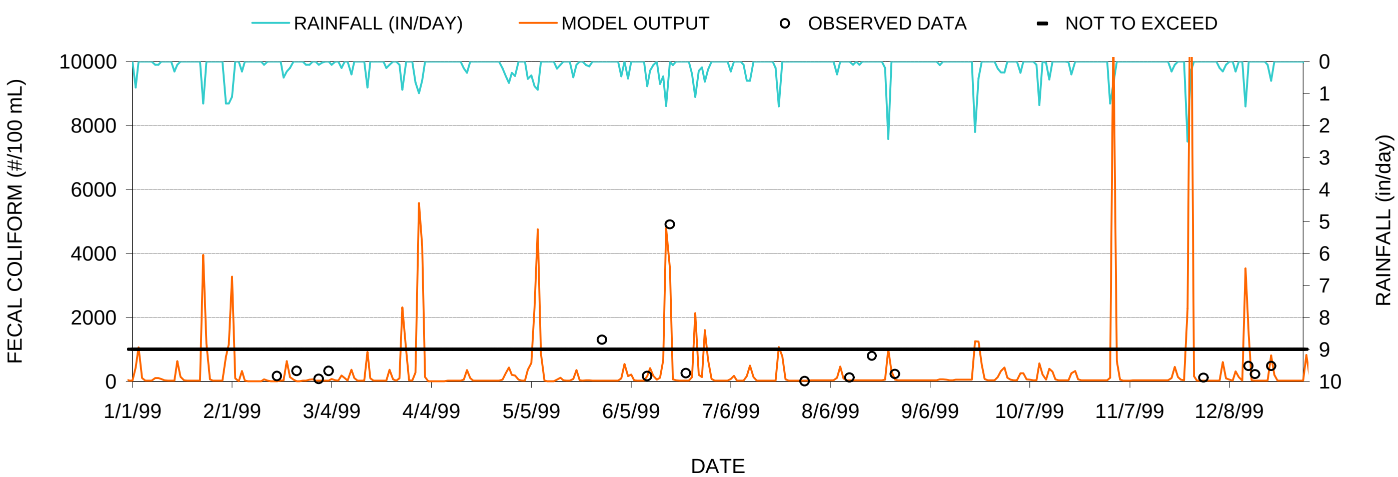


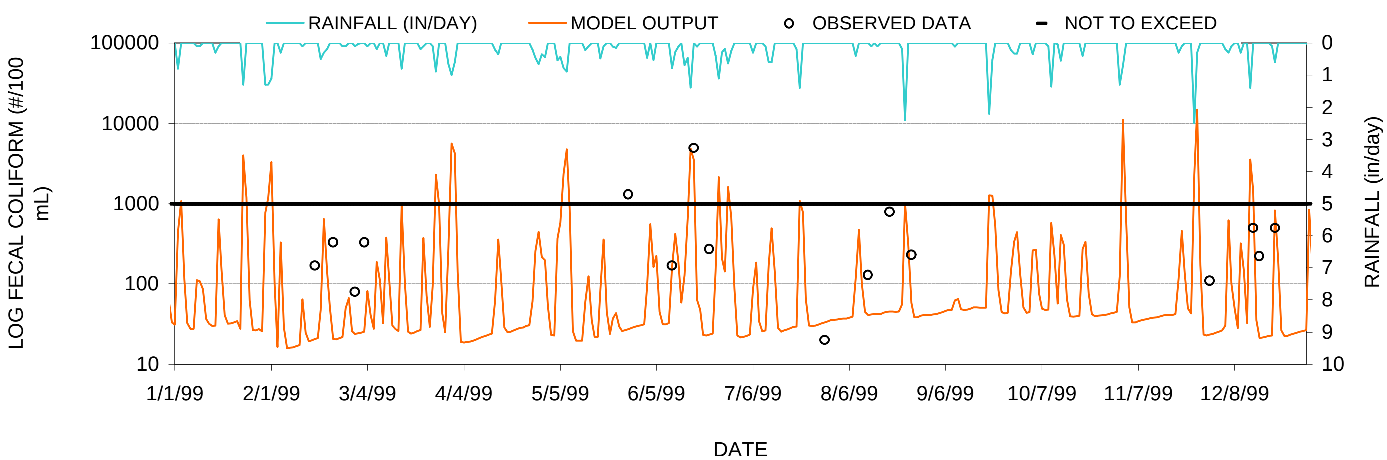
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Mulberry River (Little Mulberry R to Middle Oconee)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



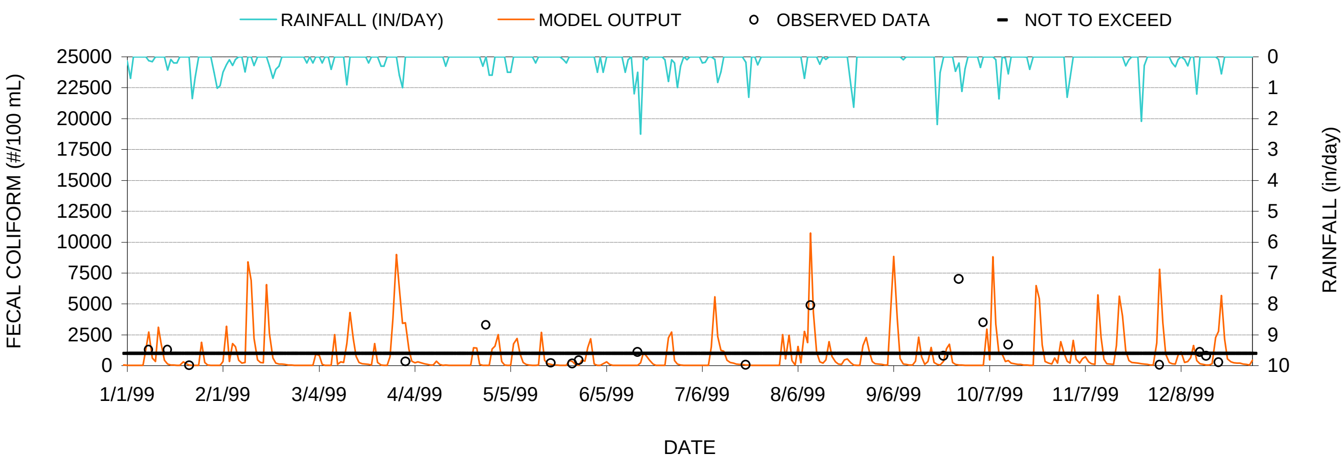


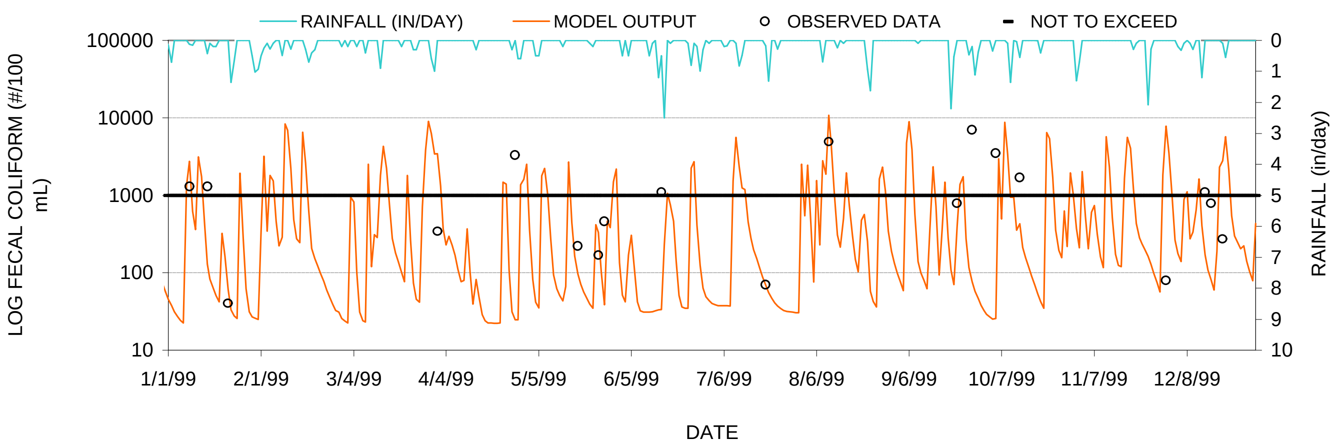
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Oconee R (confluence of North and Middle Oconee)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



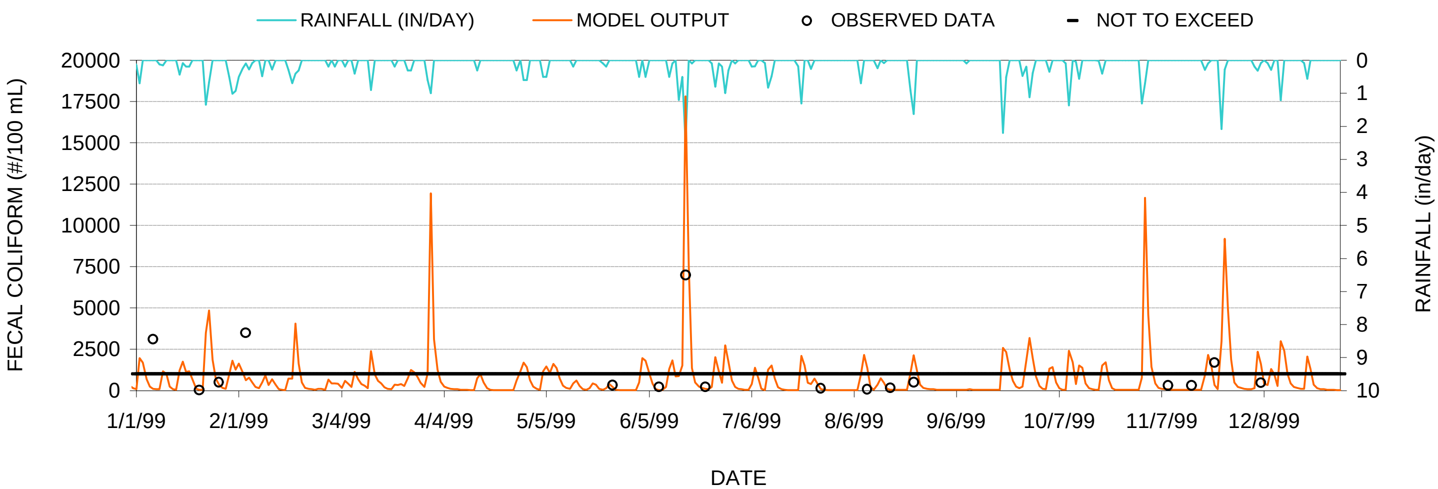


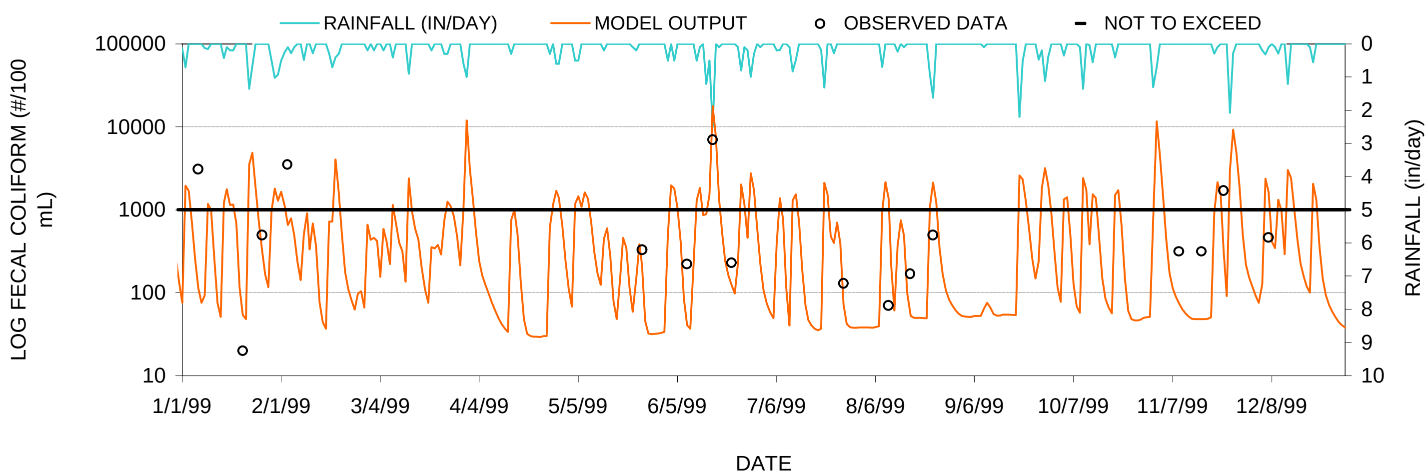
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Oconee R (Barnett Shoals to Lake Oconee)**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



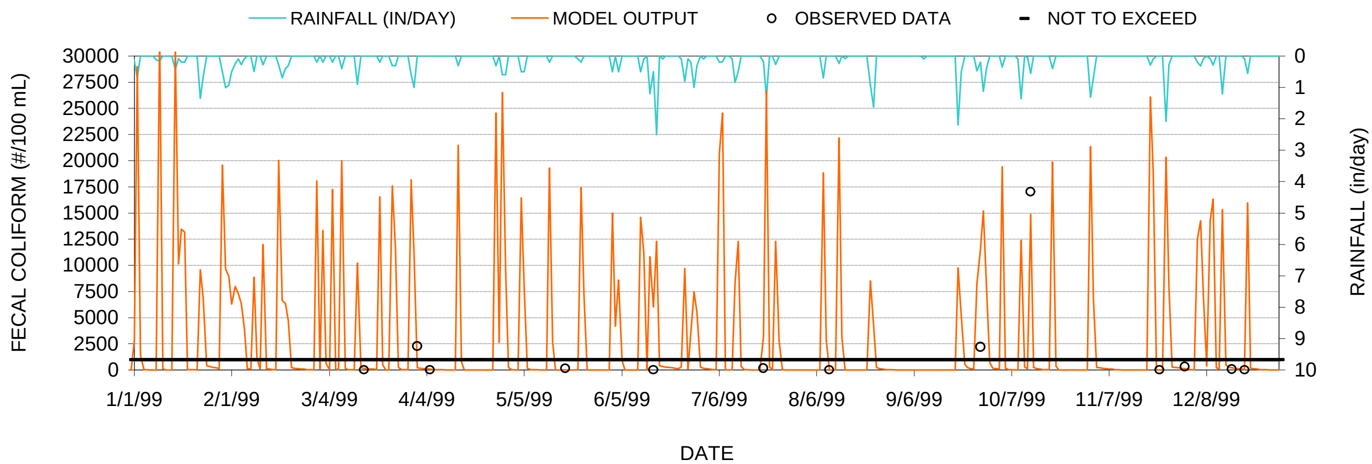


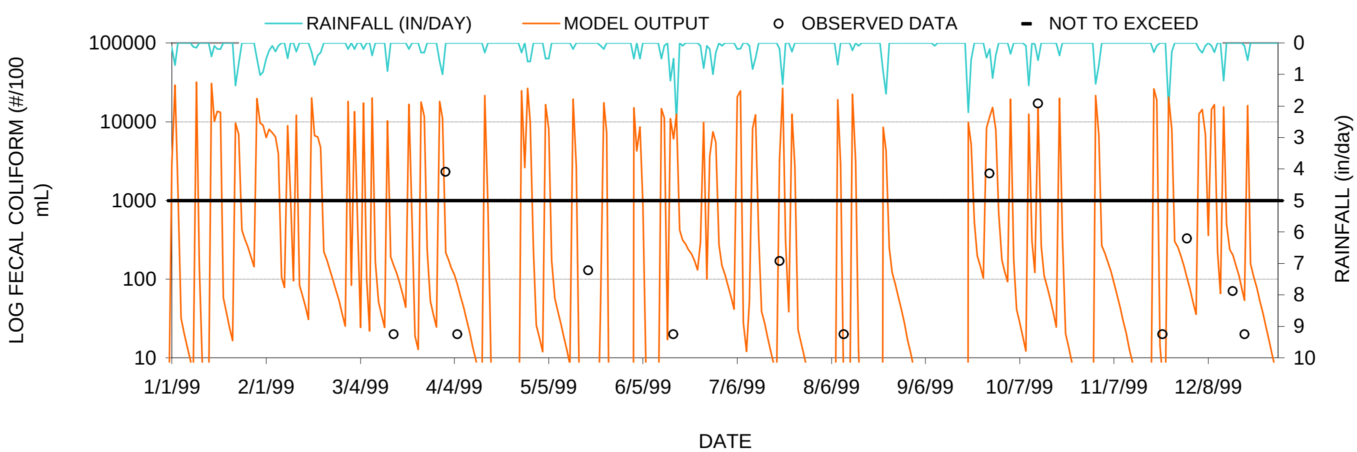
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Carr Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



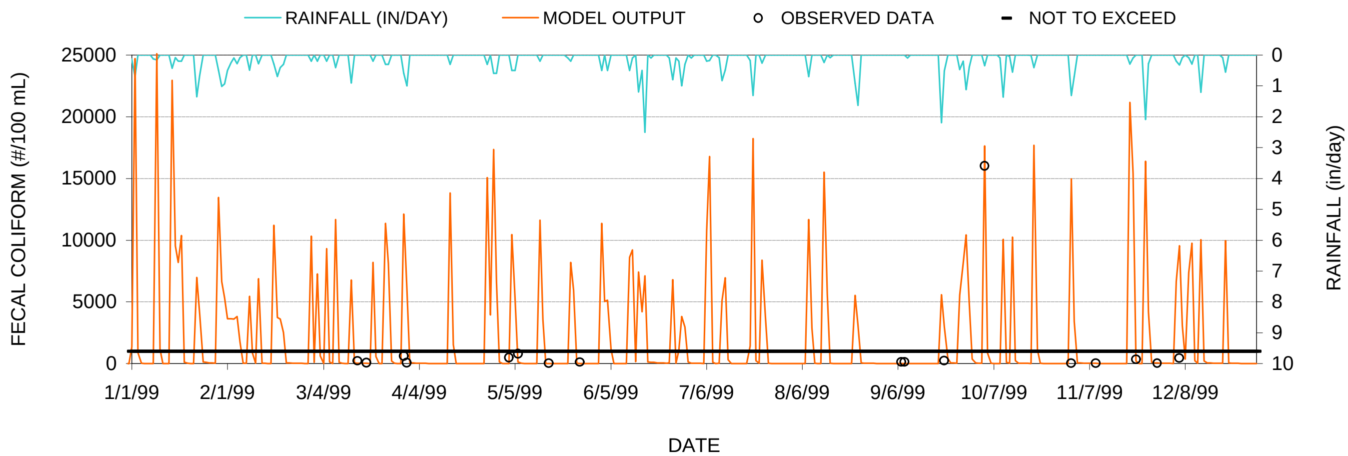


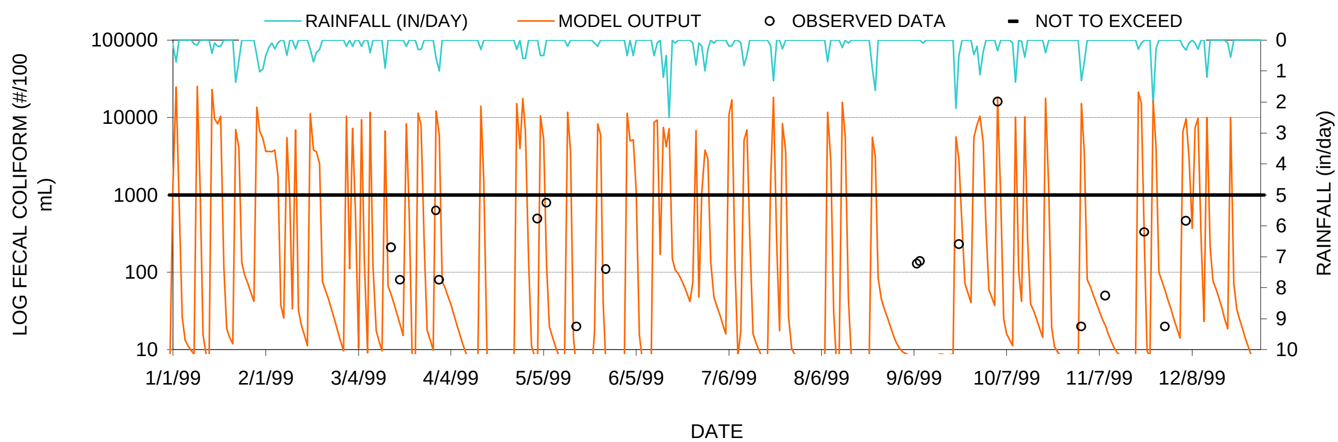
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **East Fork Trail Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



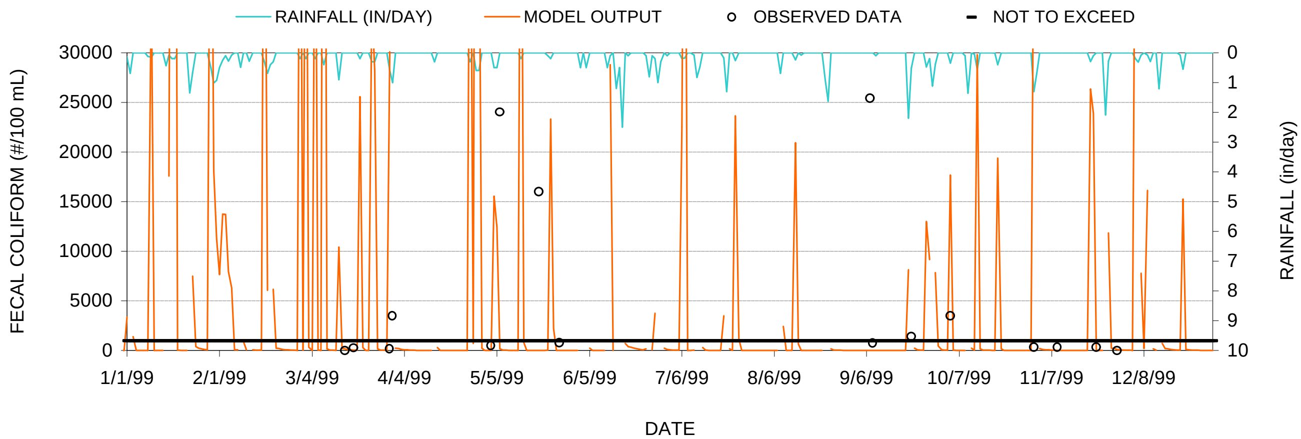


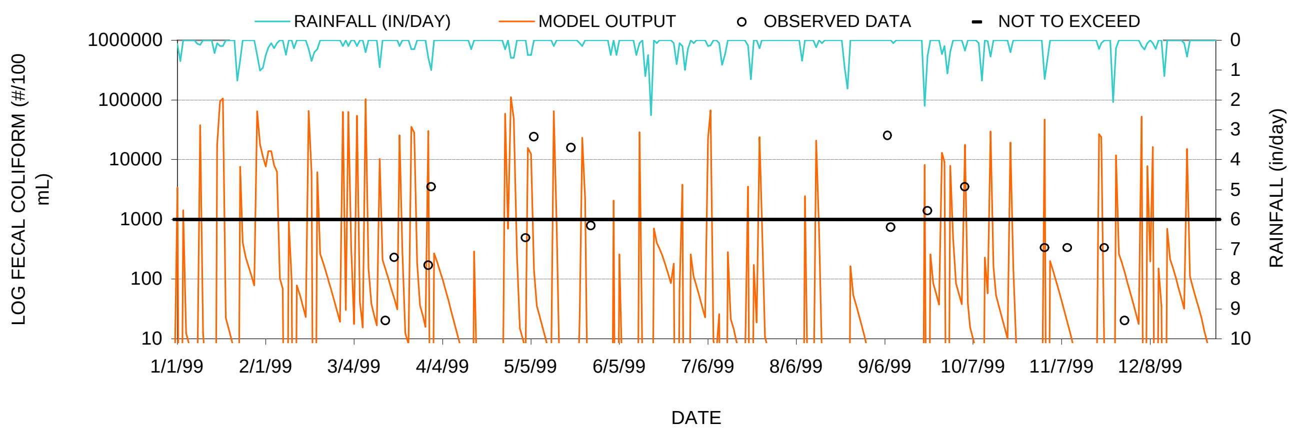
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Tanyard Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



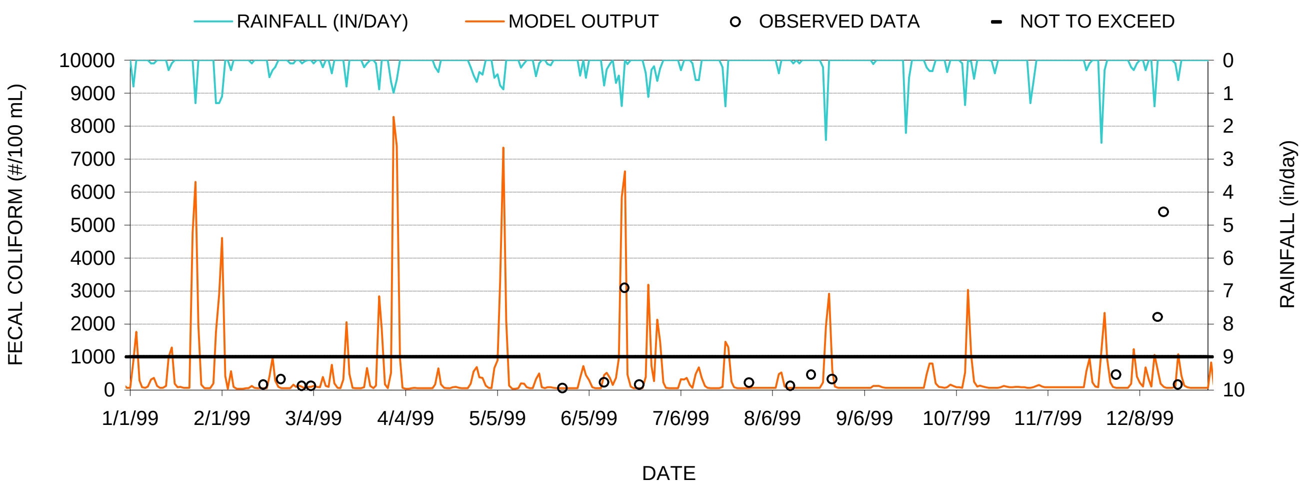


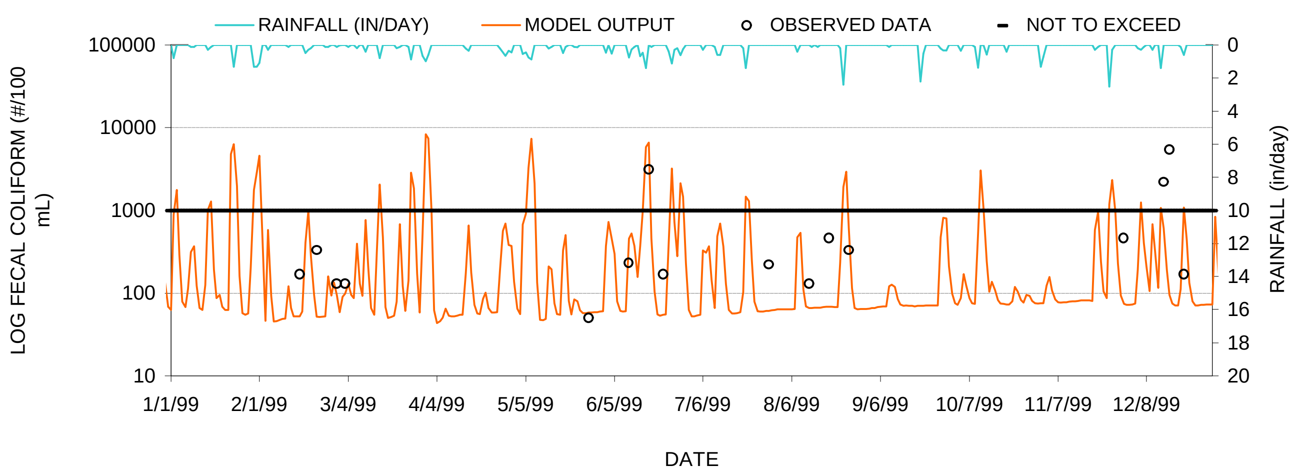
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
N. Oconee River (Bordens Cr to Curry Cr)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



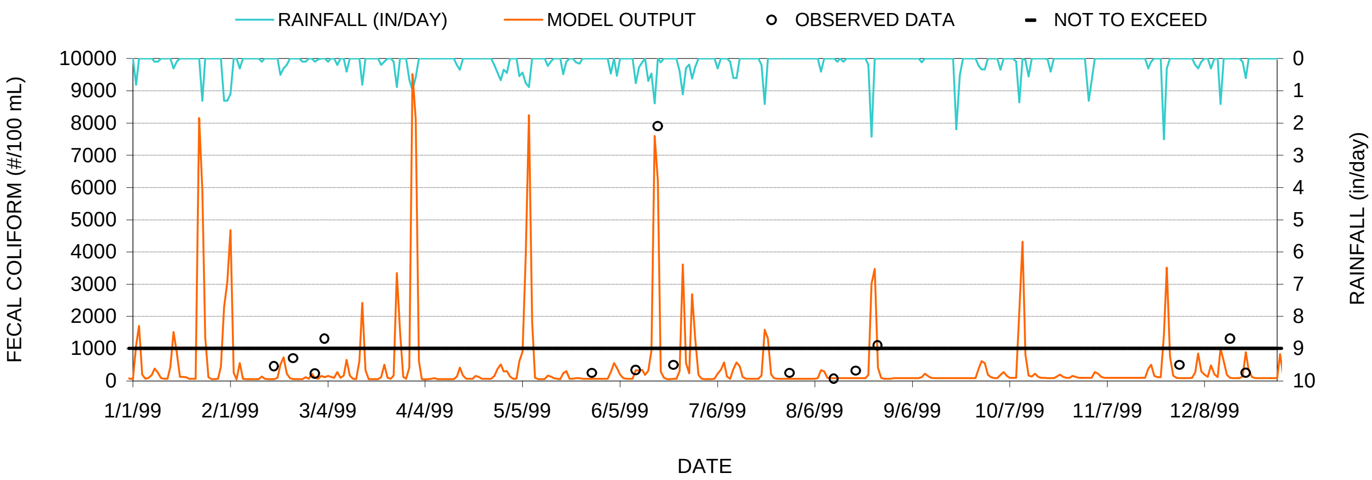


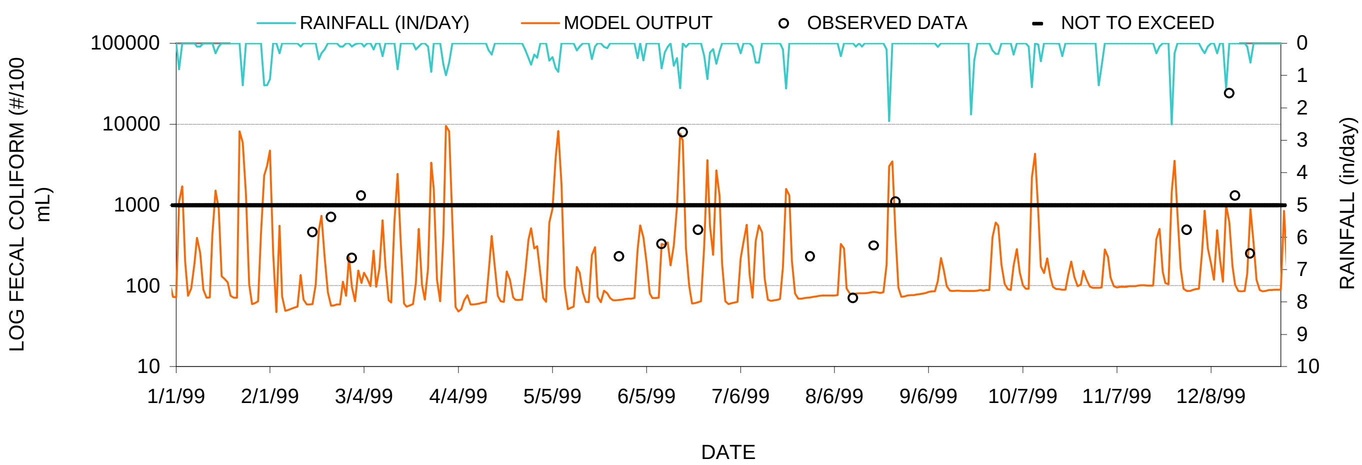
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **N. Oconee River (Chandler Creek to Bordens Cr)**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



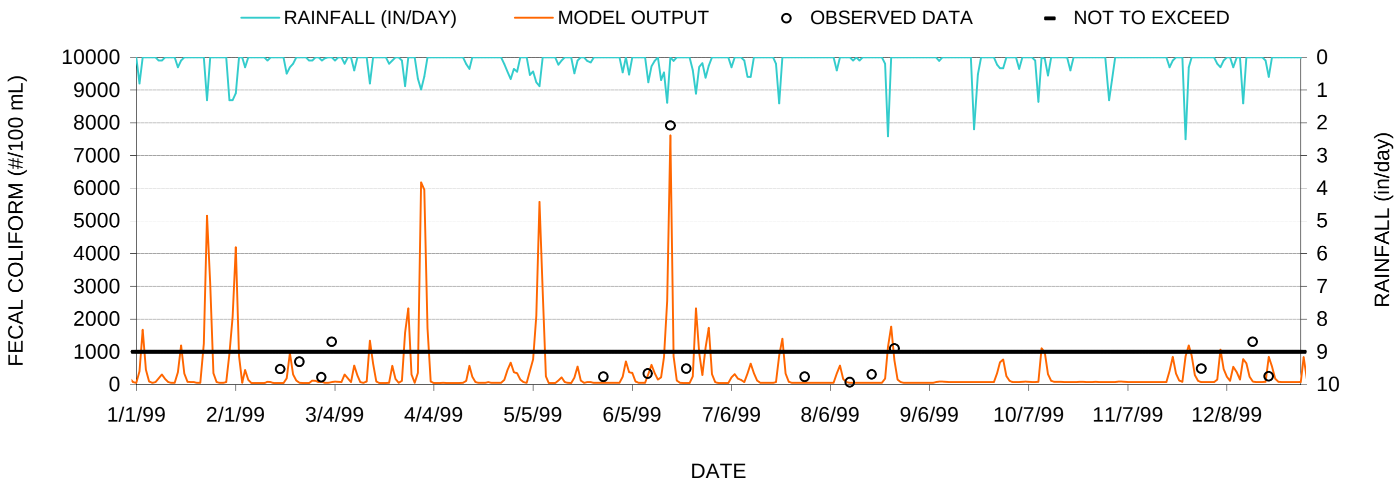


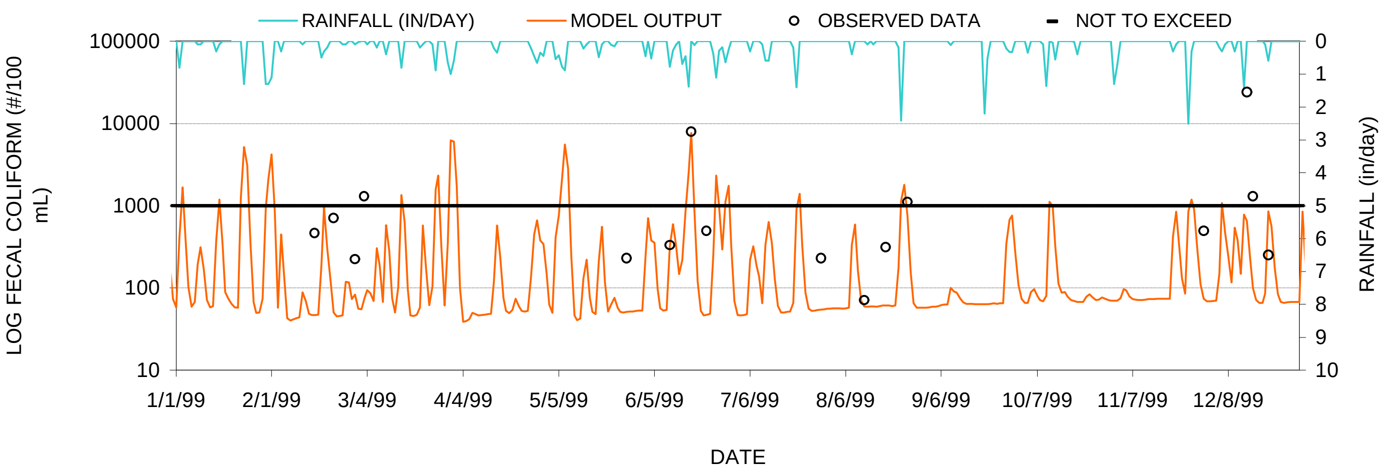
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
N. Oconee River (Jackson County to Sandy Cr)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



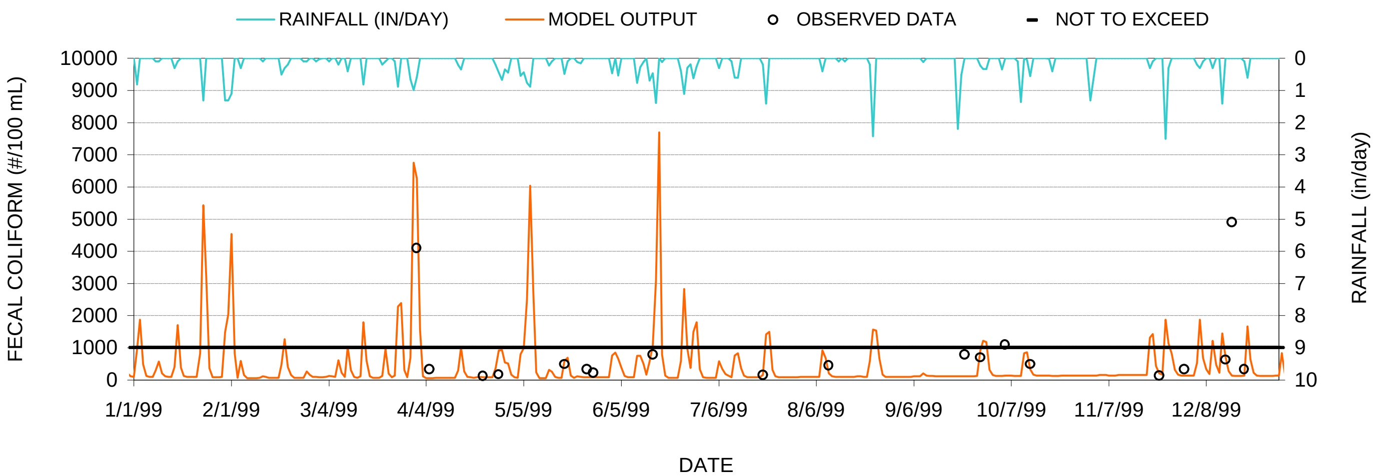


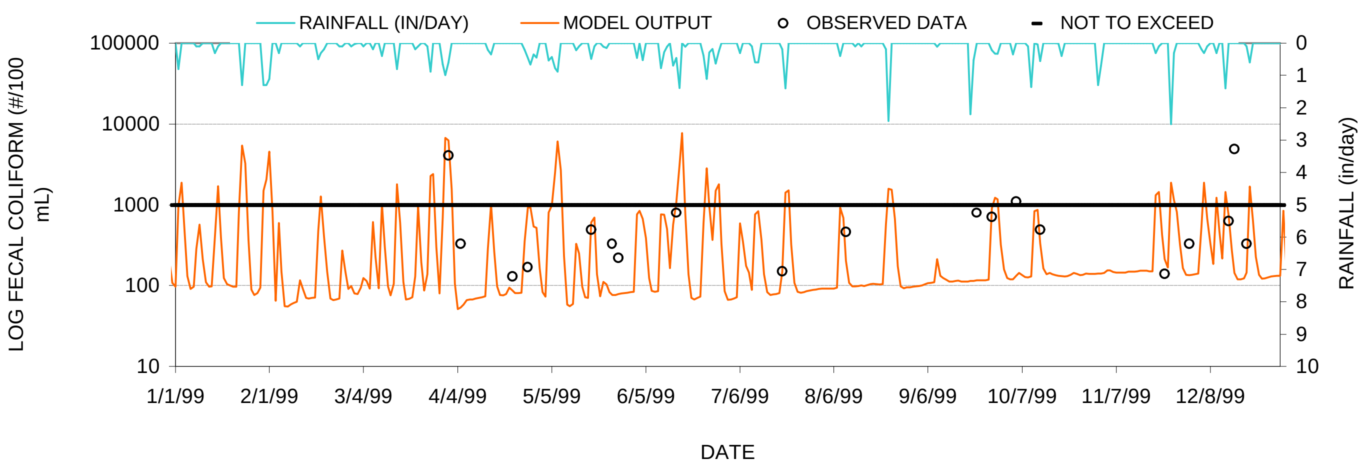
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
N. Oconee River (Sandy Creek to Trail Creek)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2

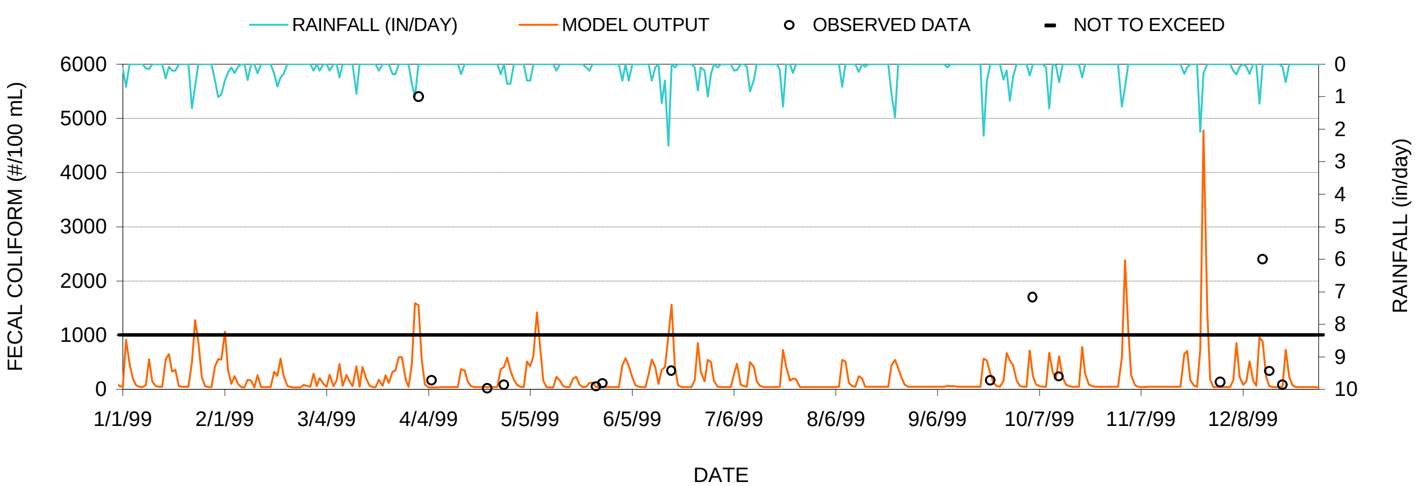


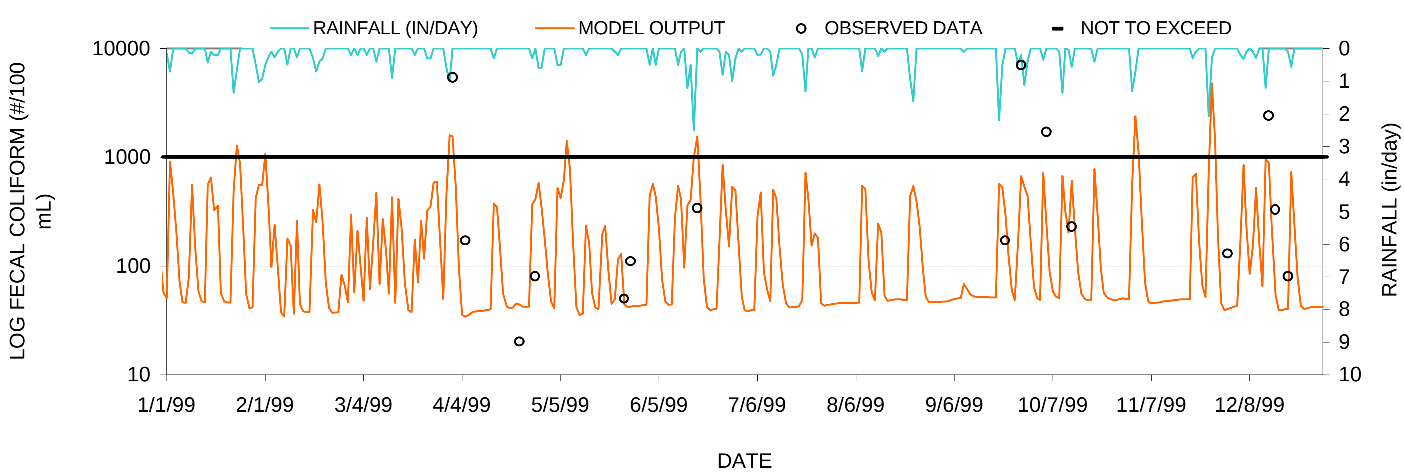


MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
N. Oconee River (Trail Cr to Oconee R)

MODEL RUN: **1**
1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



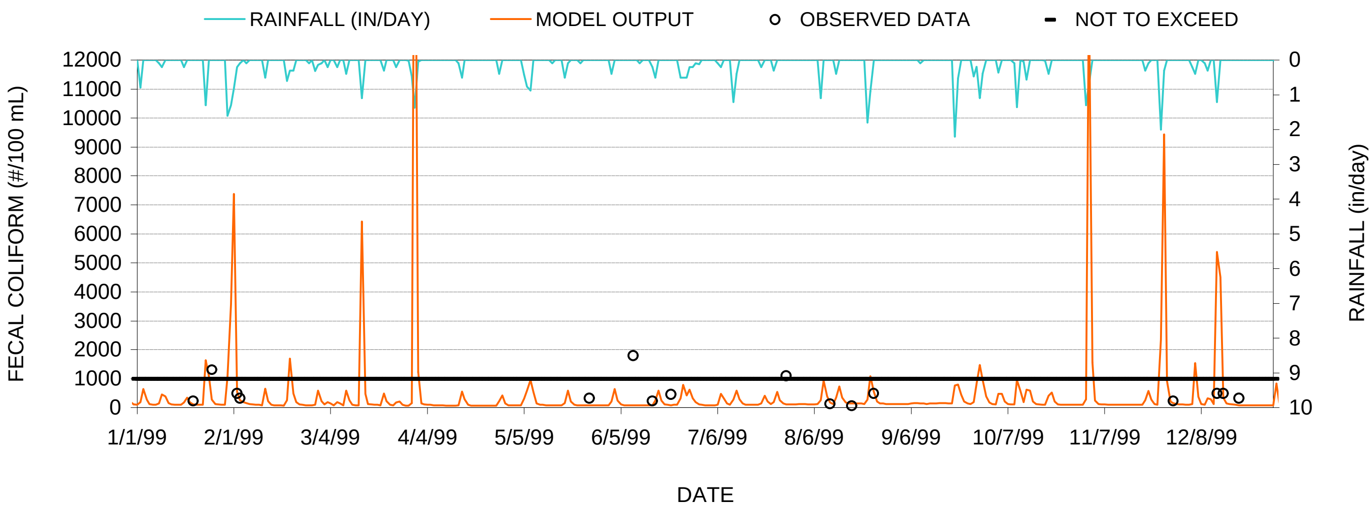


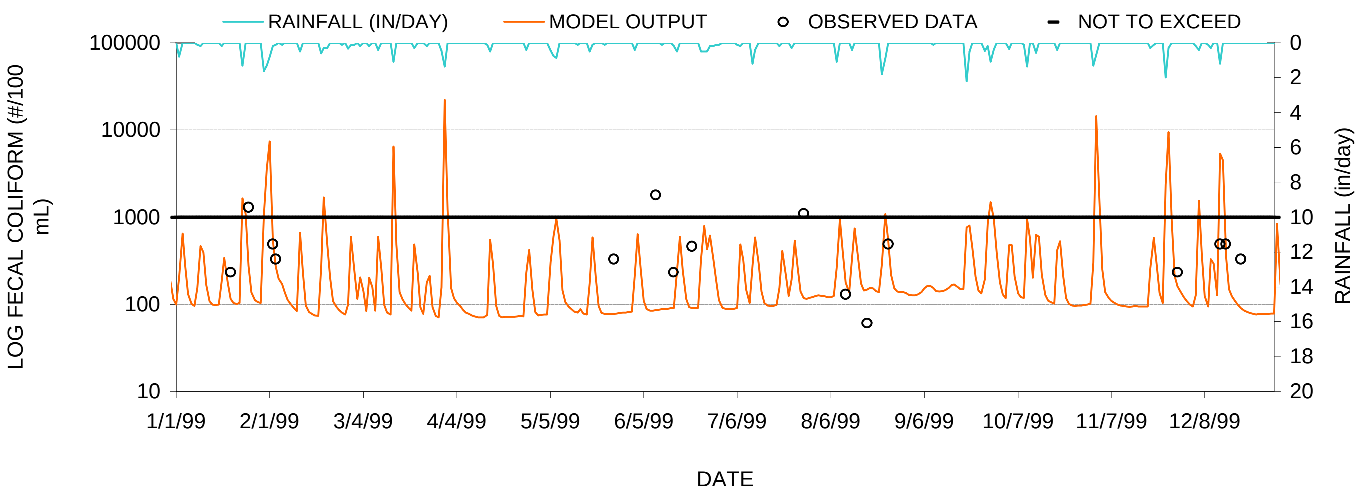
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Apalachee River (to Marburg Cr)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



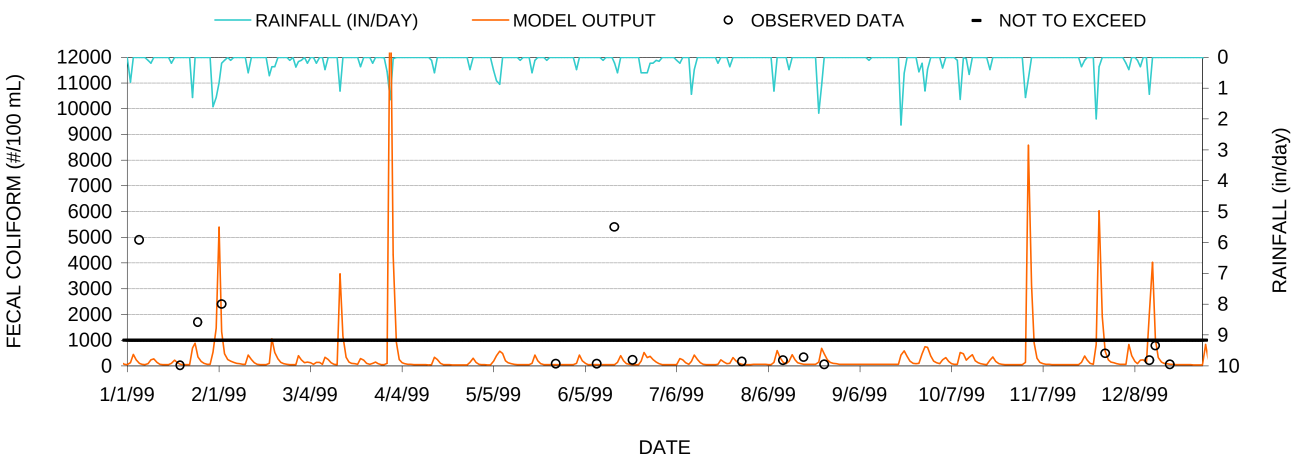


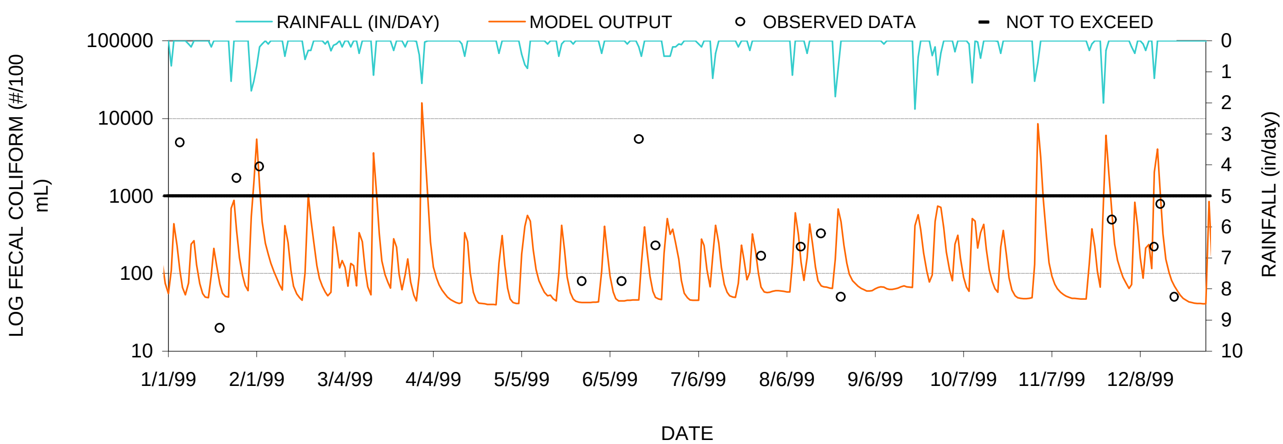
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Apalachee River (Marburg Cr to Lake Oconee)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



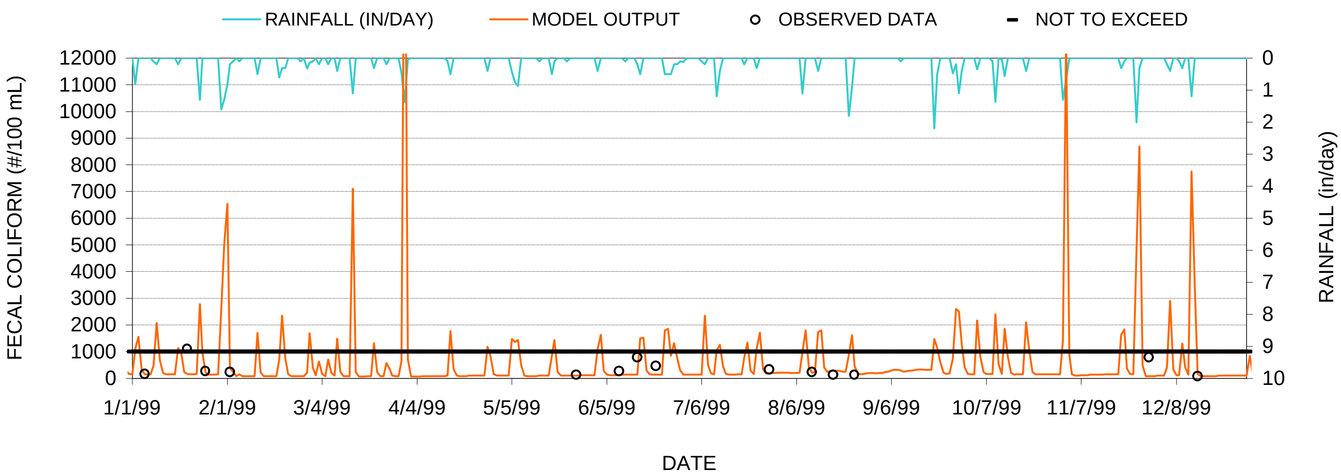


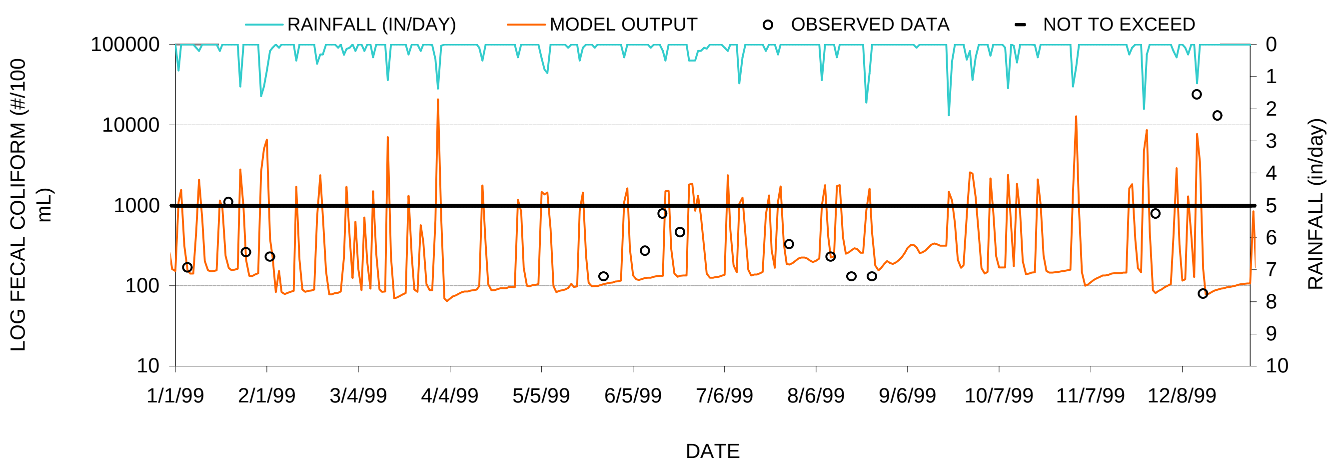
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Marburg Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



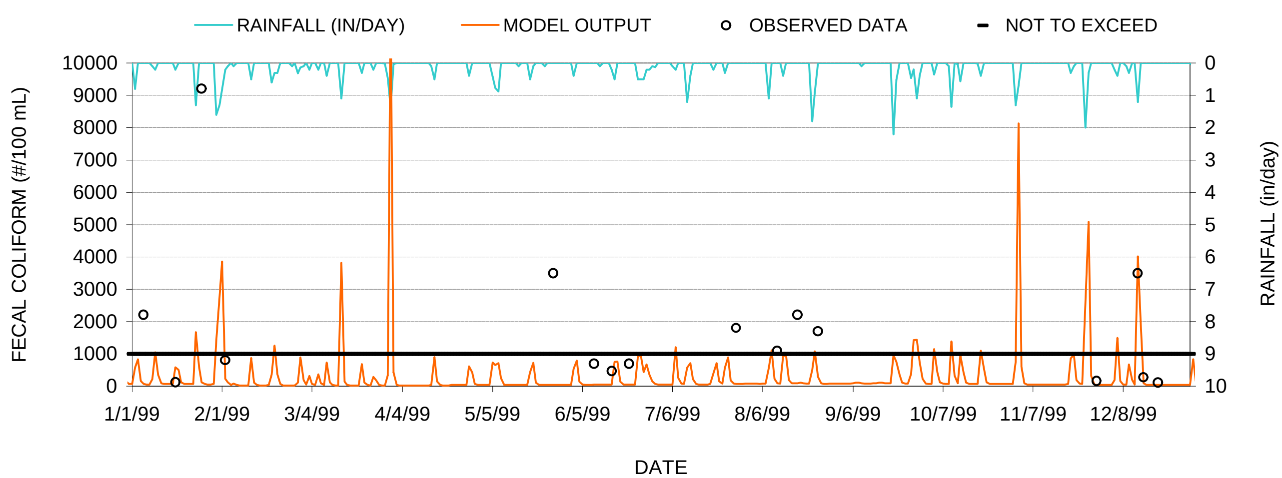


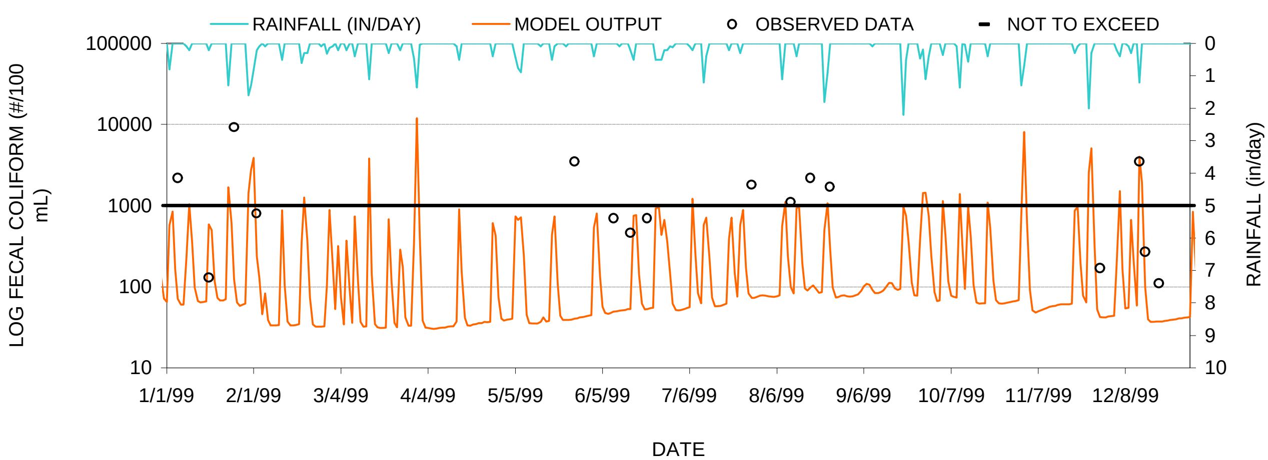
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Little River (to Nelson Cr)**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



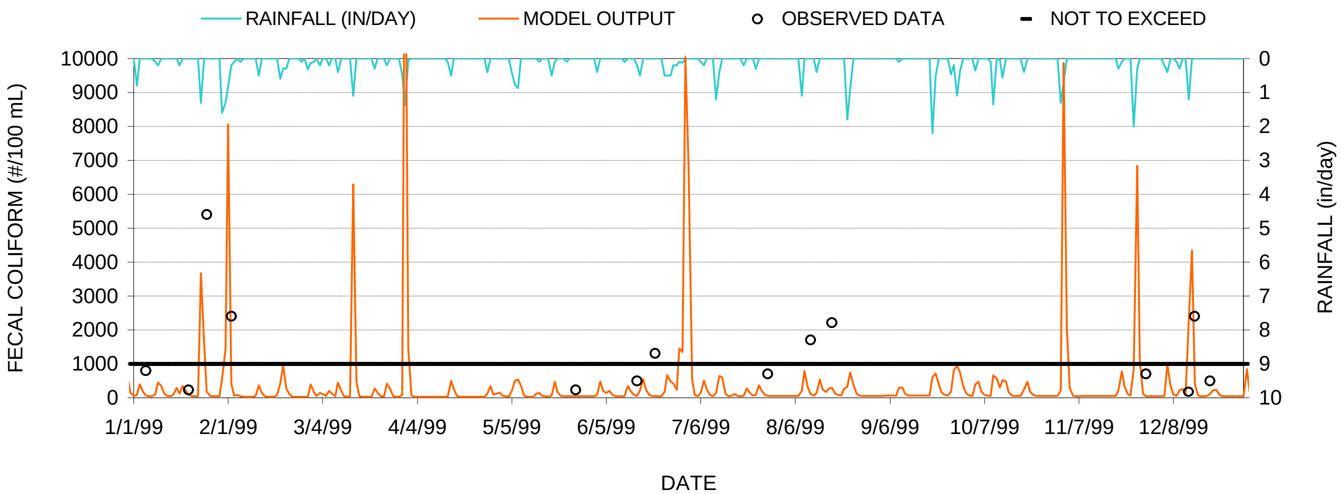


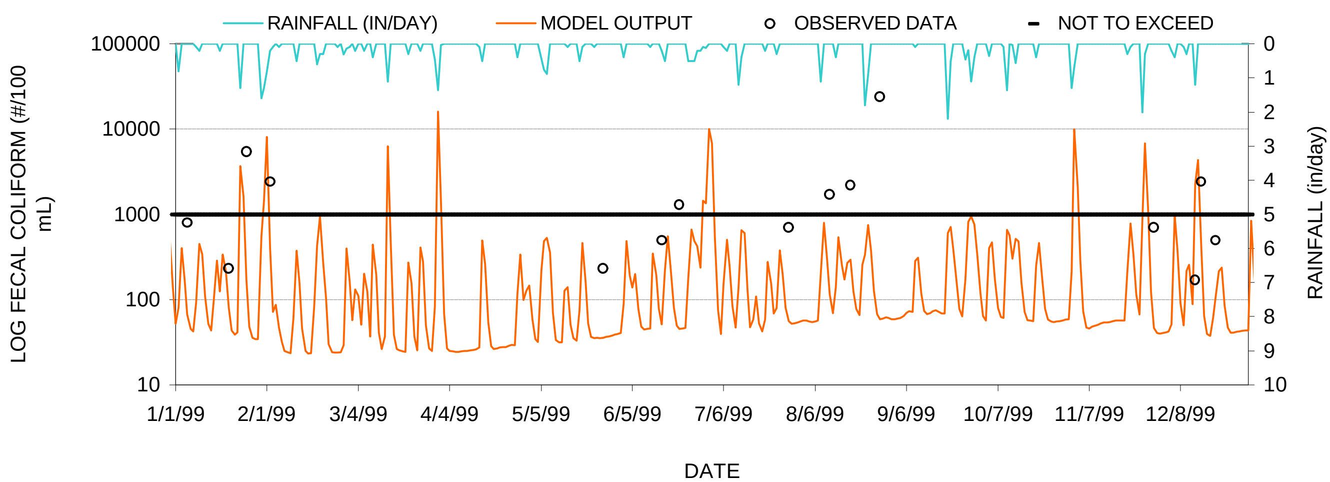
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Little River (Shoal Cr to Gap Cr)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



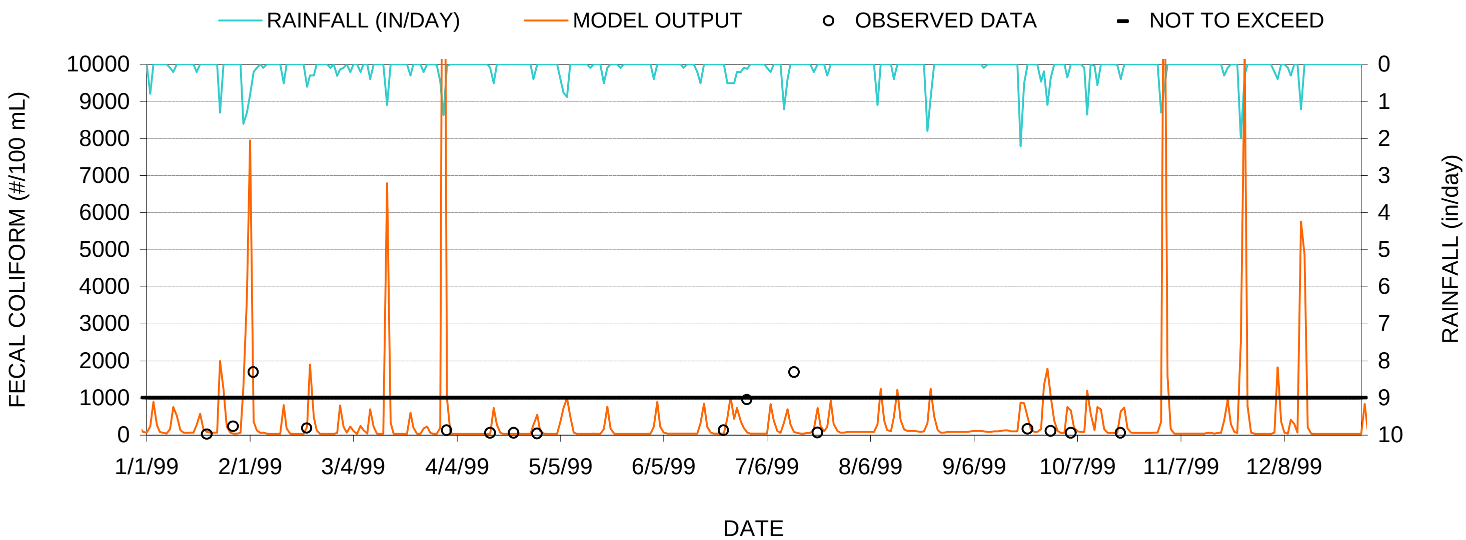


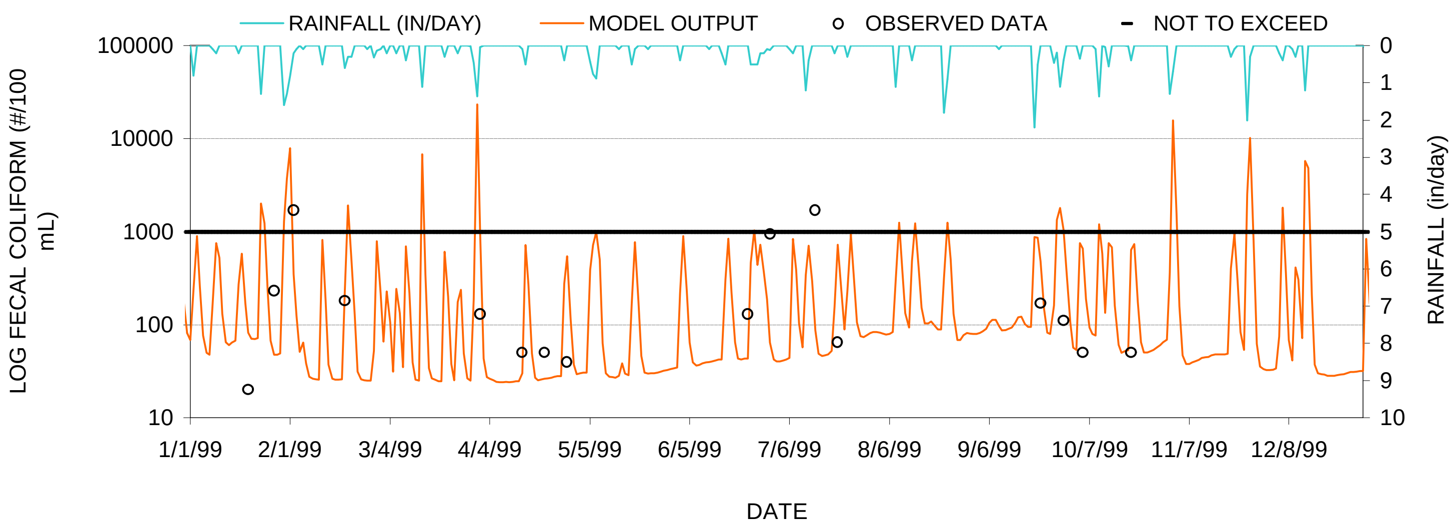
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Big Indian Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



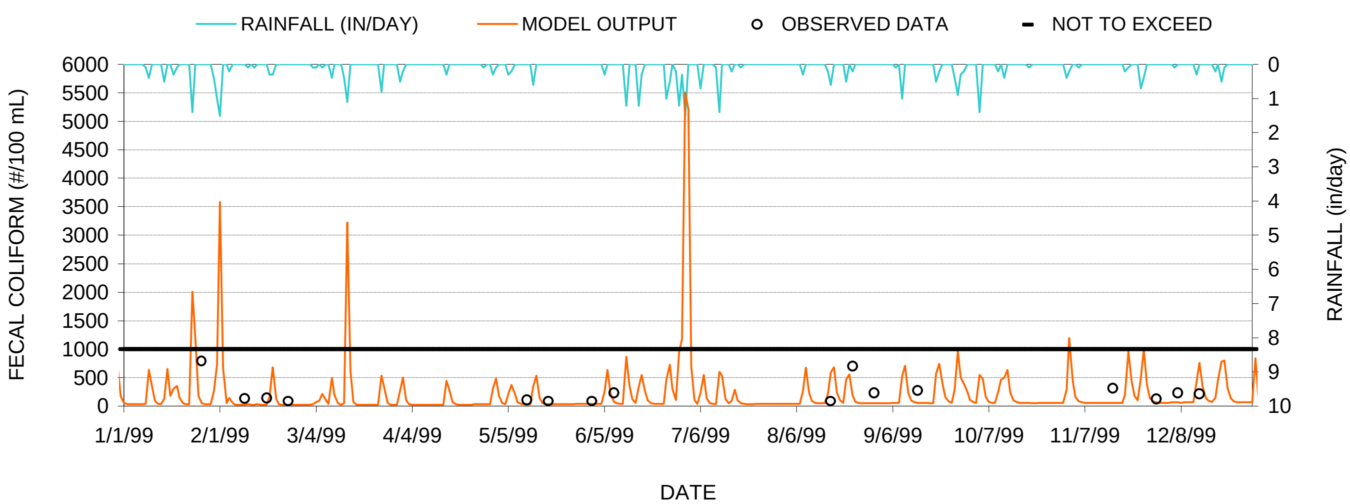


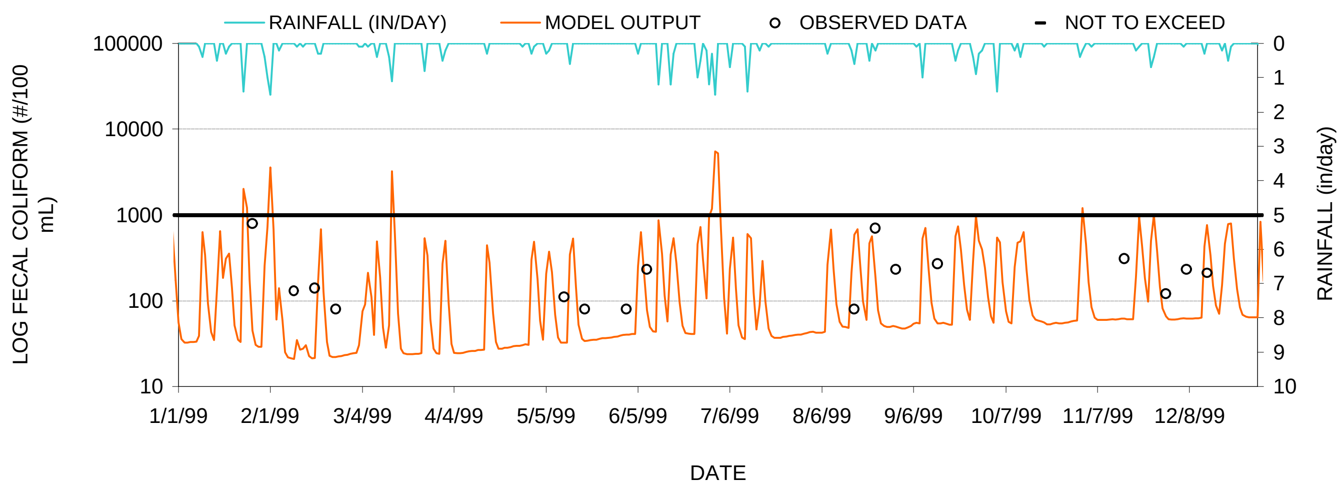
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Big Cedar Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



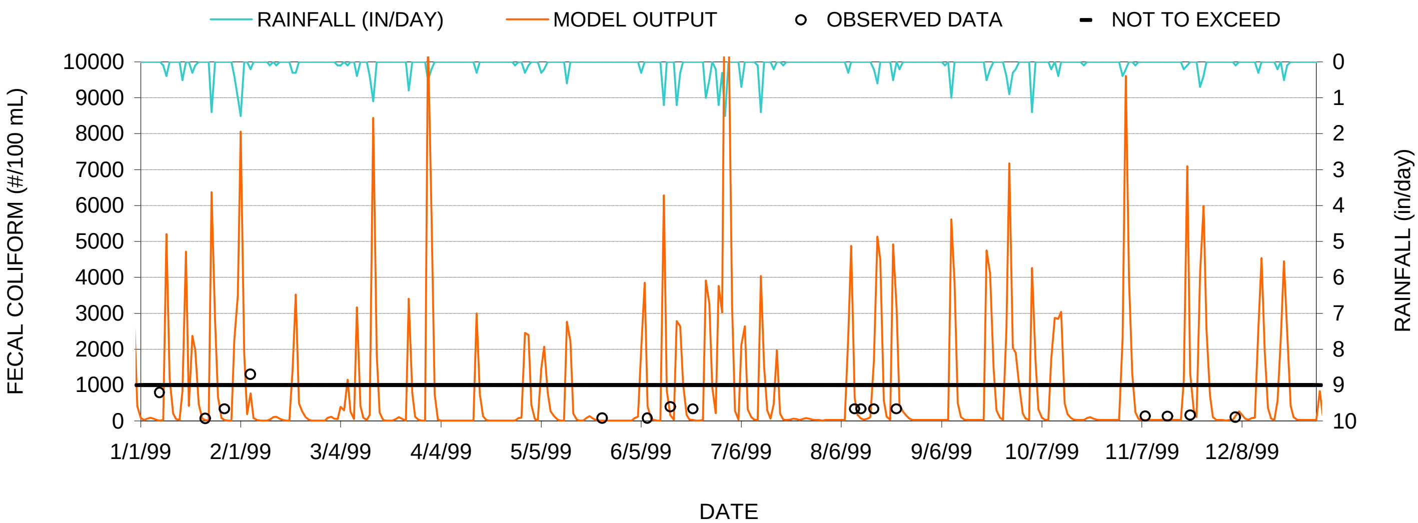


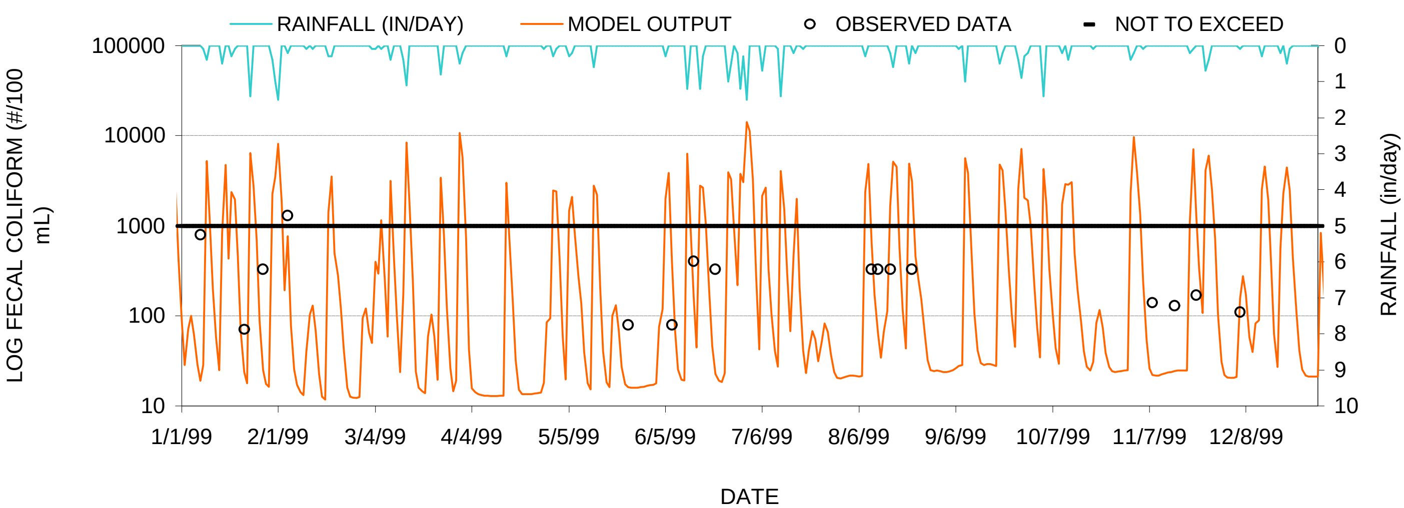
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Little River (to Lake Sinclair)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



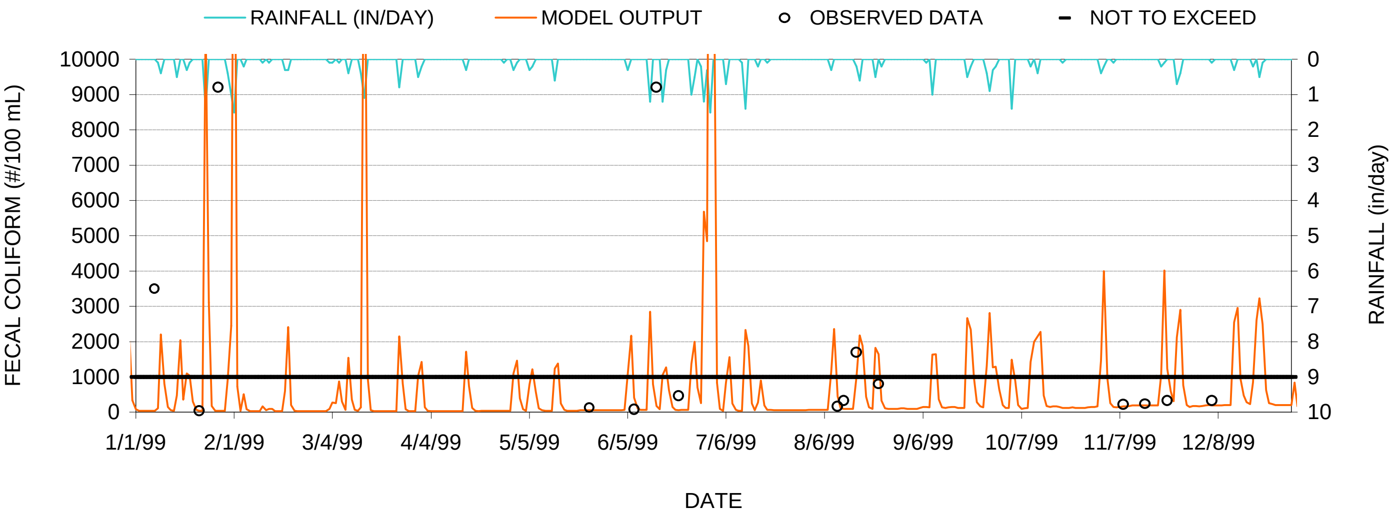


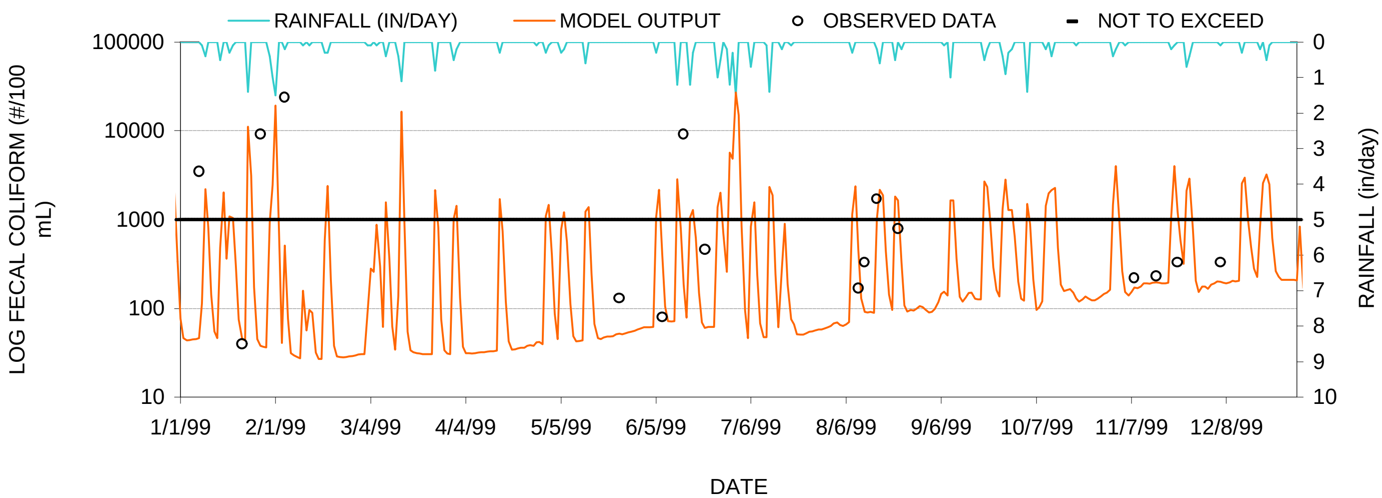
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION: **Rooty Creek**

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2



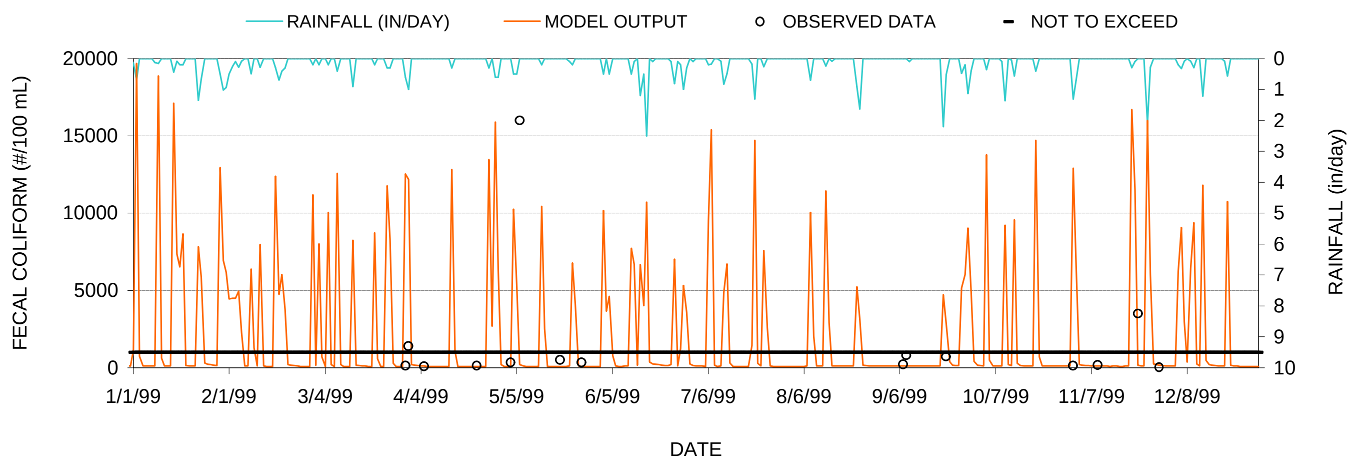


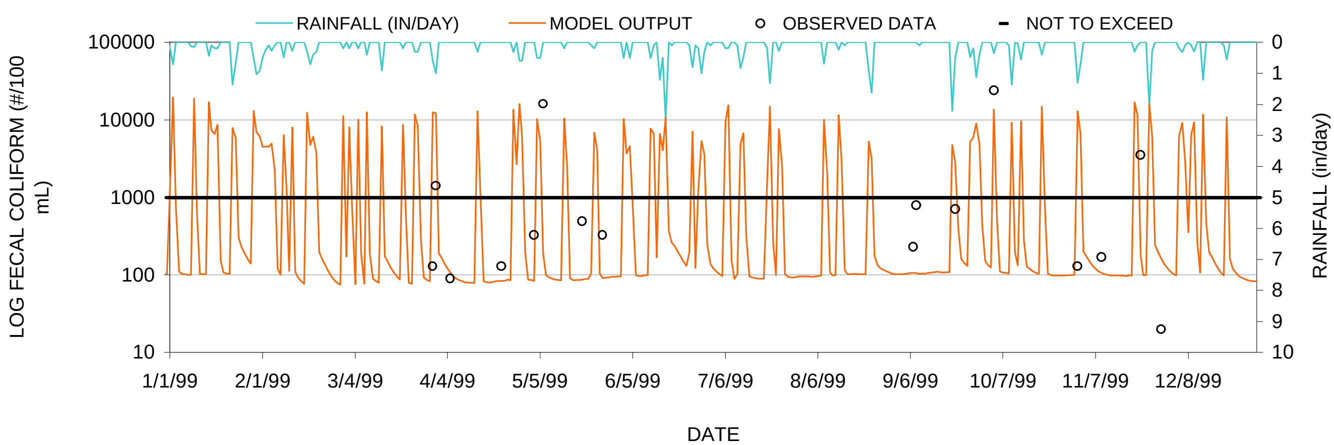
MULTI-YEAR TIMESERIES MODEL VS DATA

STATION:
Cedar Creek (Headwaters to Winder Reservoir)

MODEL RUN: **1**

1 = EXISTING
2 = ALLOCATION 1
3 = ALLOCATION 2

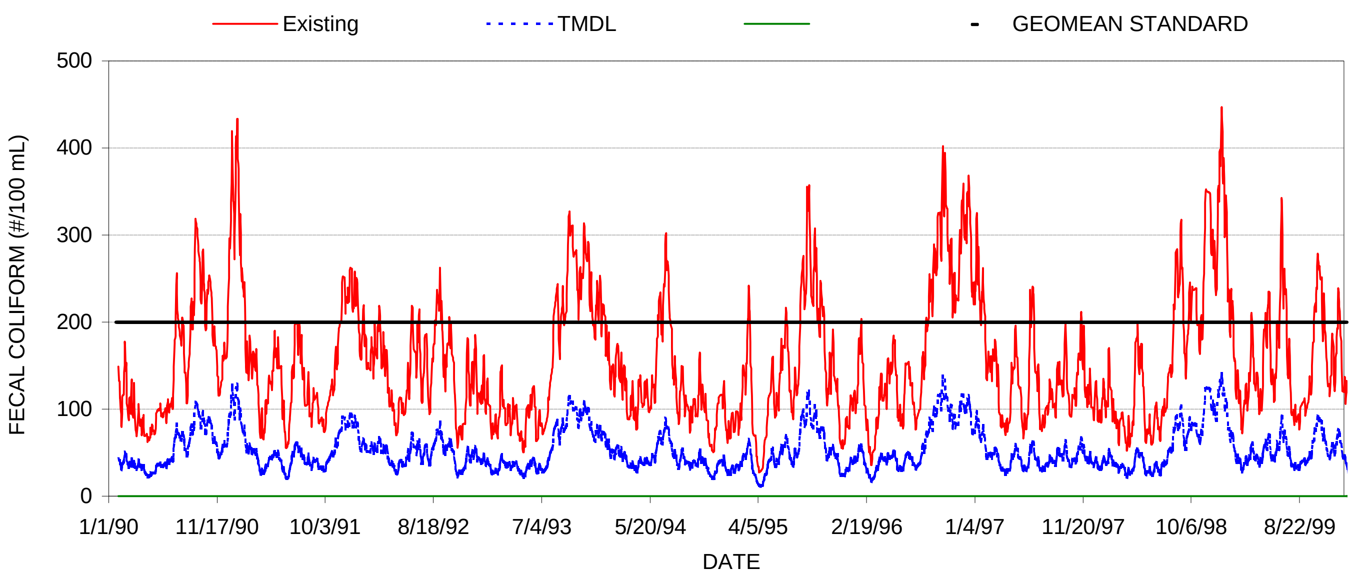




APPENDIX C:
SIMULATED 30-DAY GEOMETRIC MEAN CONCENTRATIONS

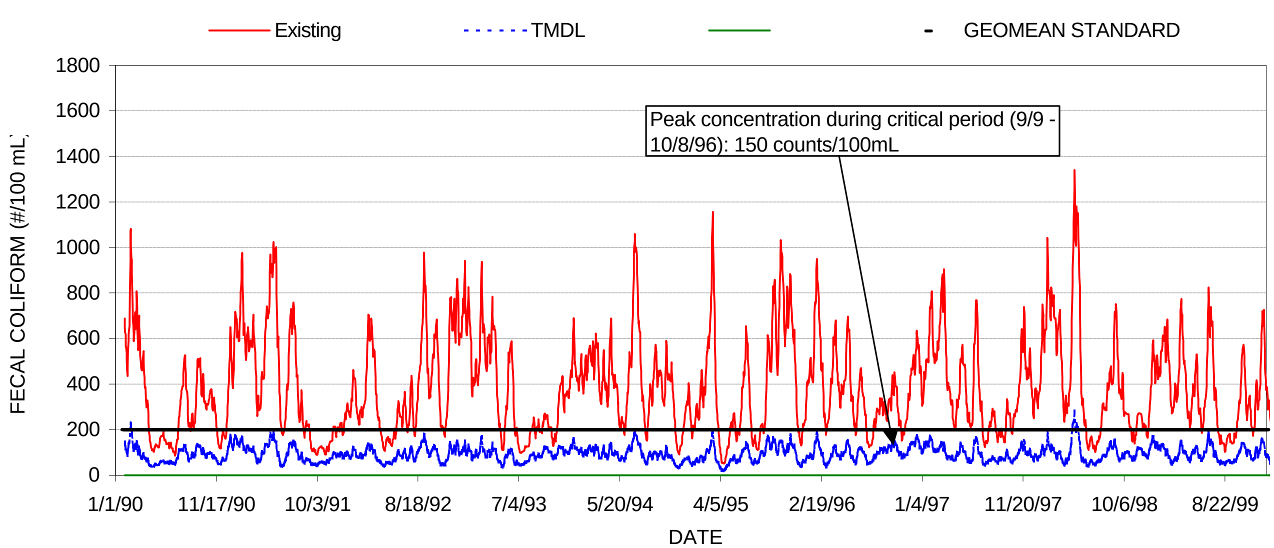
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Cedar Creek (Headwaters to Oconee R)



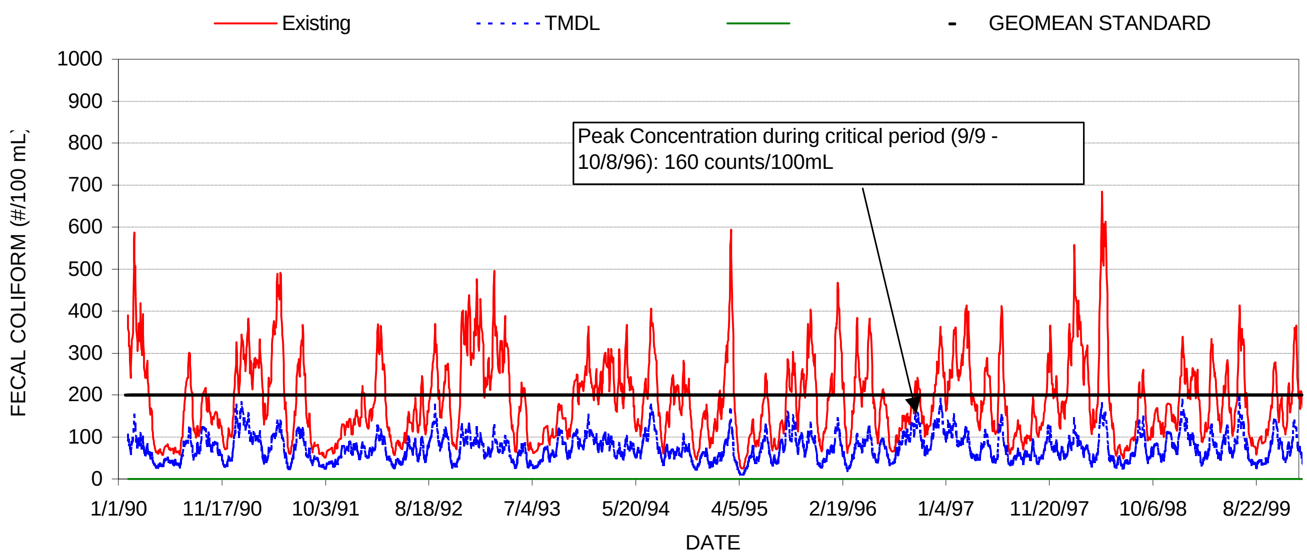
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Middle Oconee R (Mulberry R to Big Bear Cr)



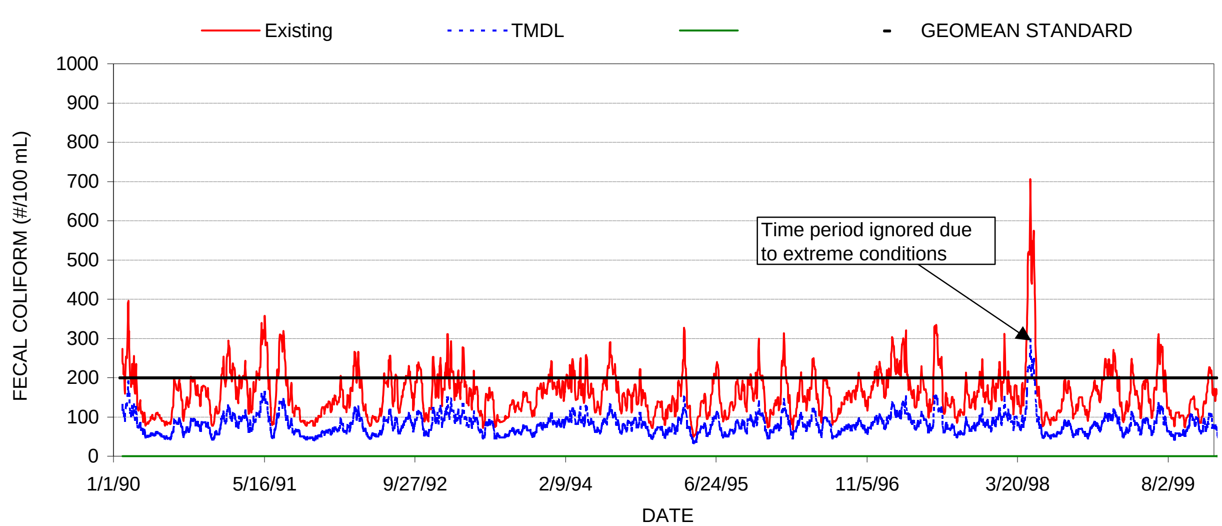
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

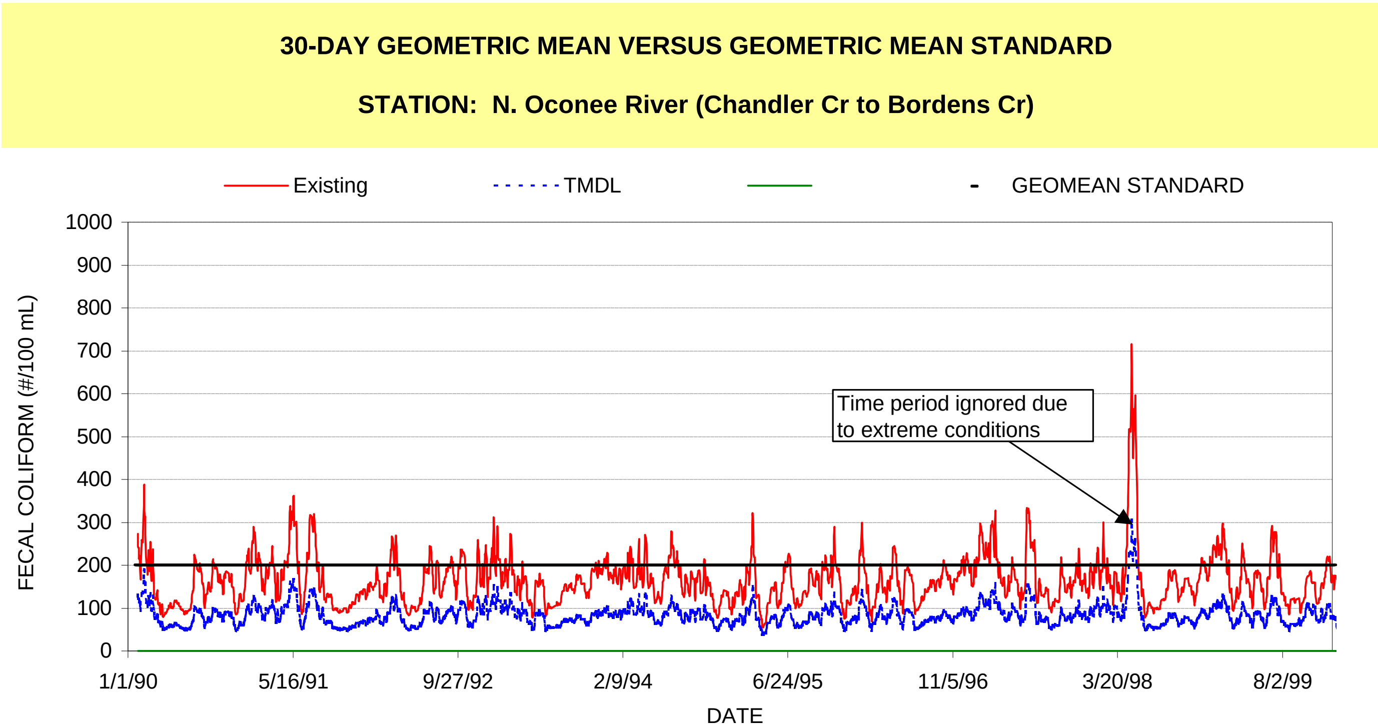
STATION: Middle Oconee R (Big Bear Cr to McNutt Cr)

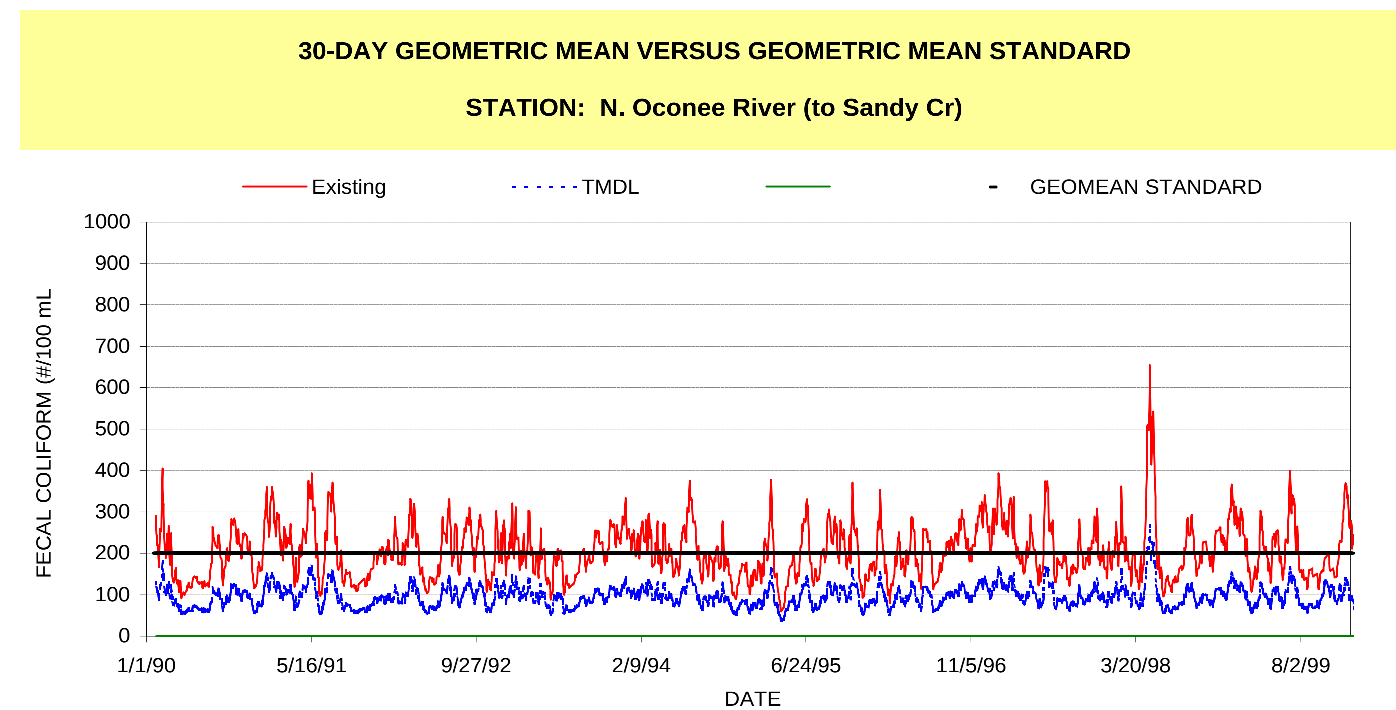


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: N. Oconee River (Bordens Cr to Curry Cr)

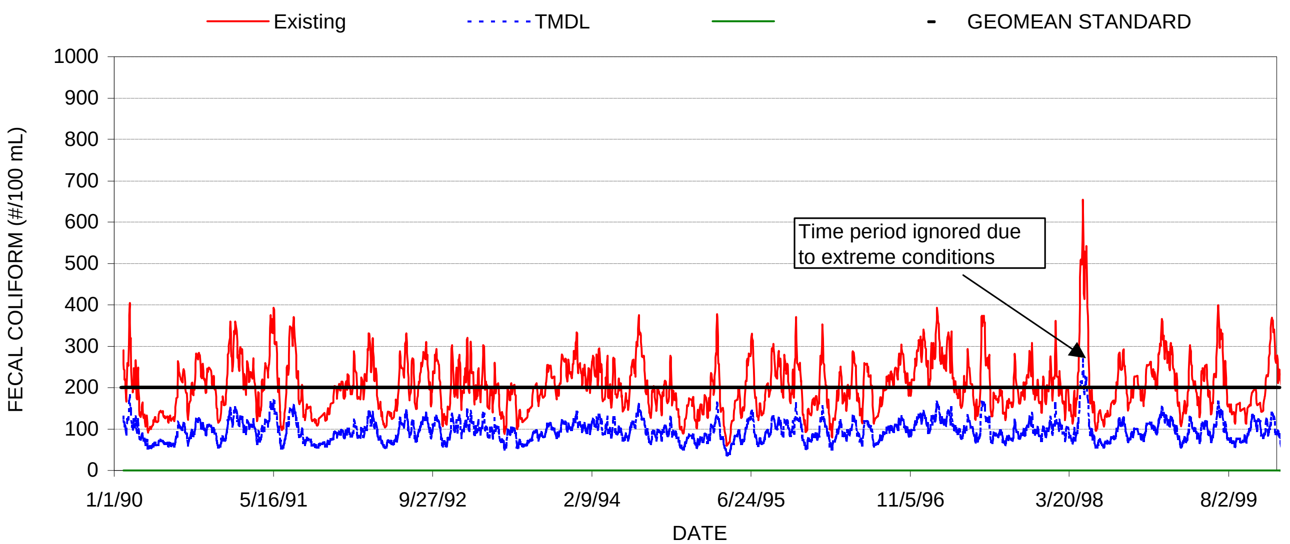



30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: N. Oconee River (Chandler Cr to Bordens Cr)
Existing
TMDL
GEOMEAN STANDARD
Time period ignored due to extreme conditions
FECAL COLIFORM (#/100 mL)
0
100
200
300
400
500
600
700
800
900
1000
1/1/90
5/16/91
9/27/92
2/9/94
6/24/95
11/5/96
3/20/98
8/2/99
DATE


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: N. Oconee River (to Sandy Cr)
Existing
TMDL
GEOMEAN STANDARD
FECAL COLIFORM (#/100 mL
0
100
200
300
400
500
600
700
800
900
1000
1/1/90
5/16/91
9/27/92
2/9/94
6/24/95
11/5/96
3/20/98
8/2/99
DATE

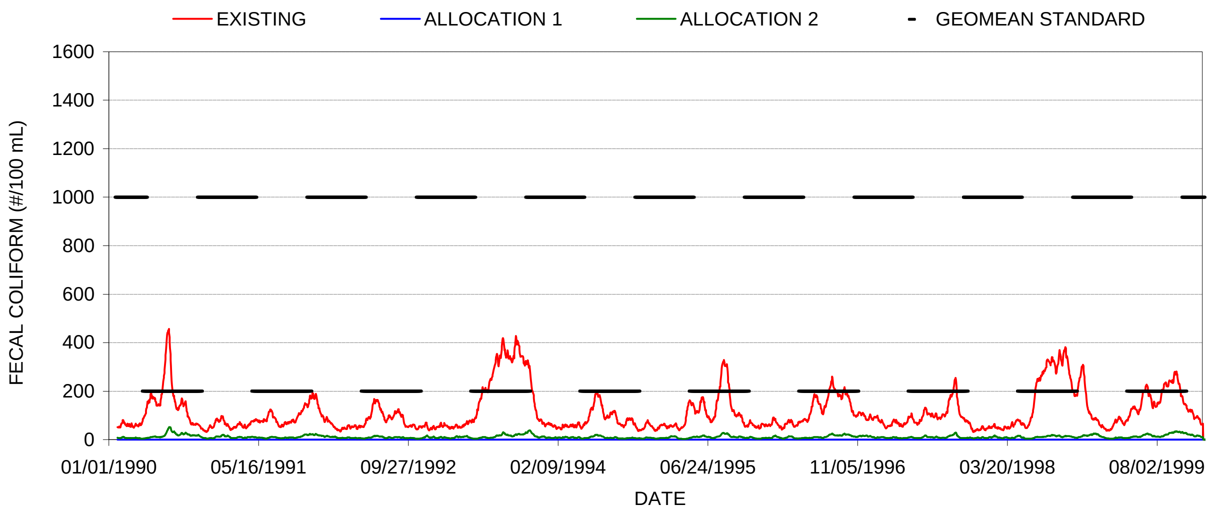
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: N. Oconee River (Sandy Cr to Trail Cr)



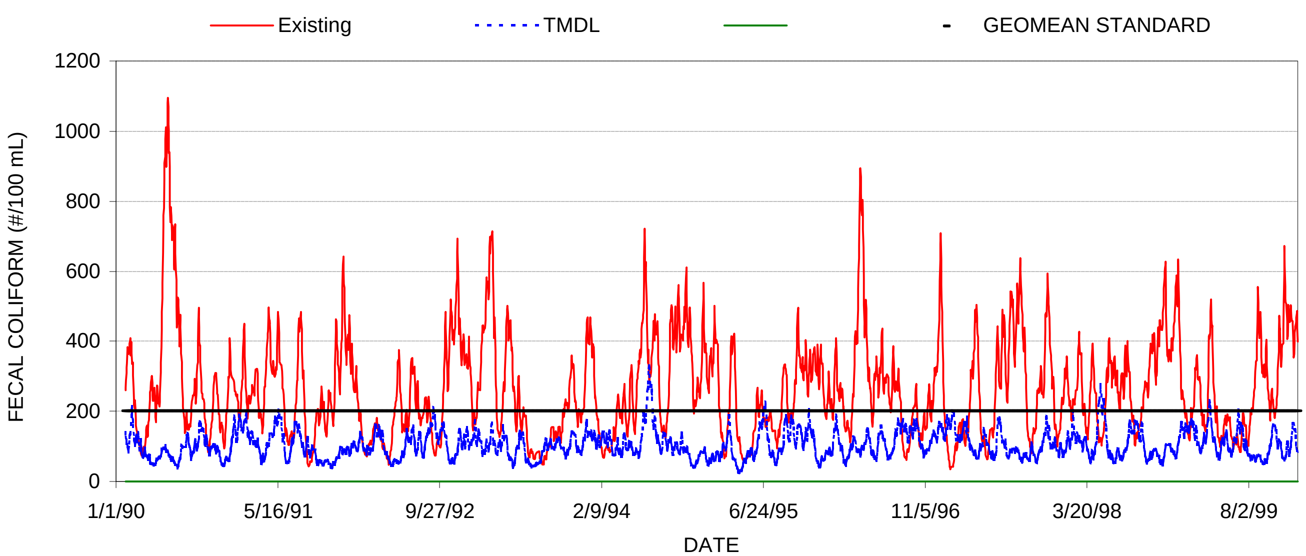
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Oconee River, Long Branch to Turkey Creek; Lower Oconee Basin



30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Oconee River (to Barnett Shoals Dam)

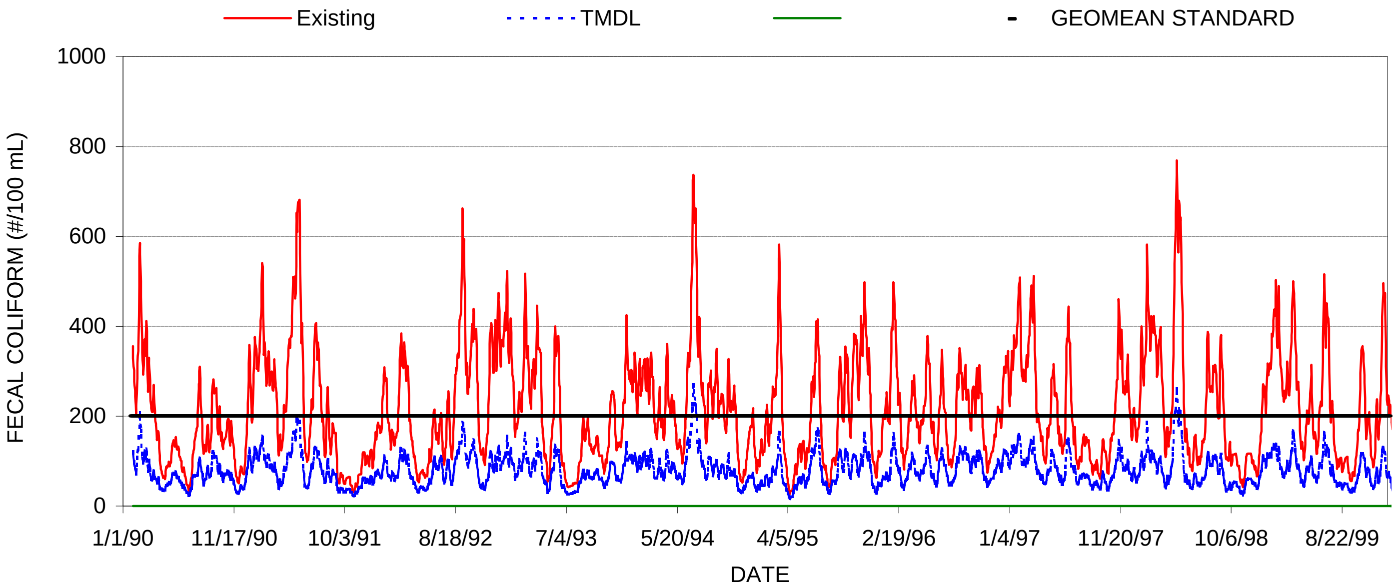


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: East Fork Trail Creek

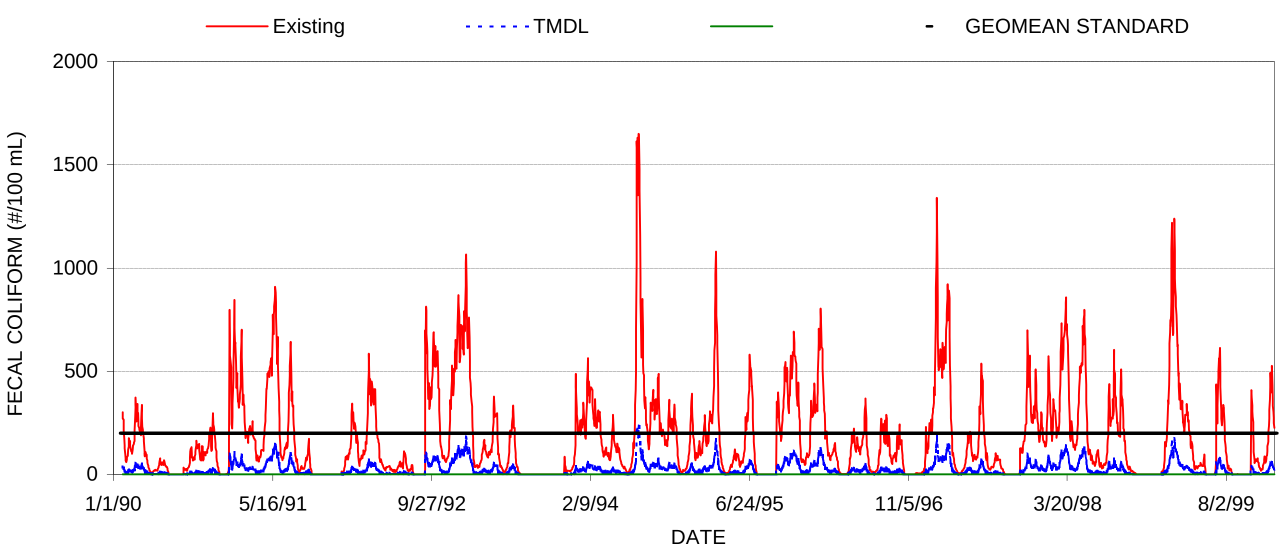
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Oconee River (below Barnett Shoals)



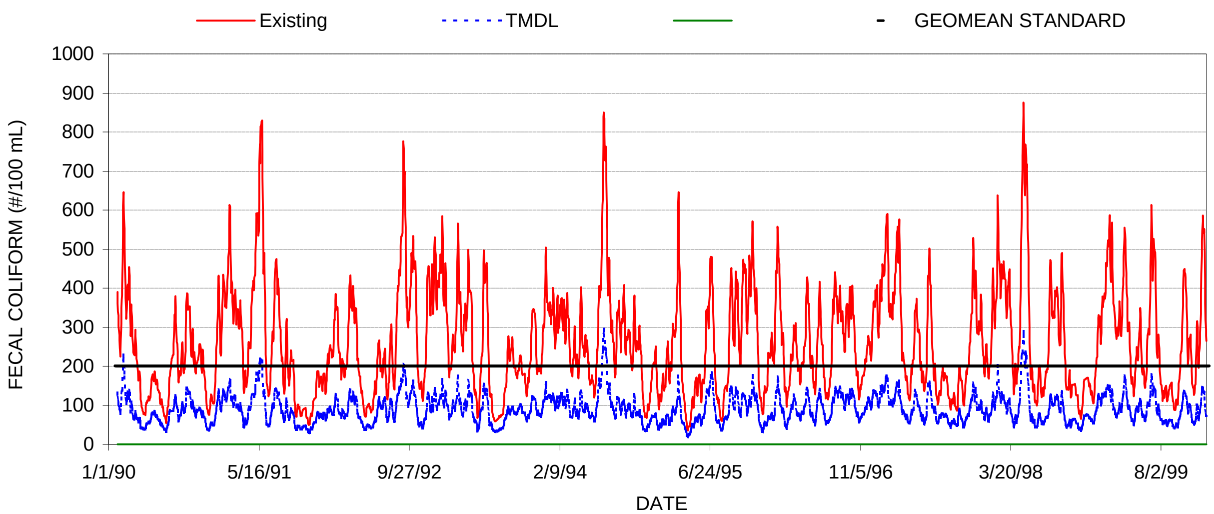
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Carr Creek (headwaters to N. Oconee R)



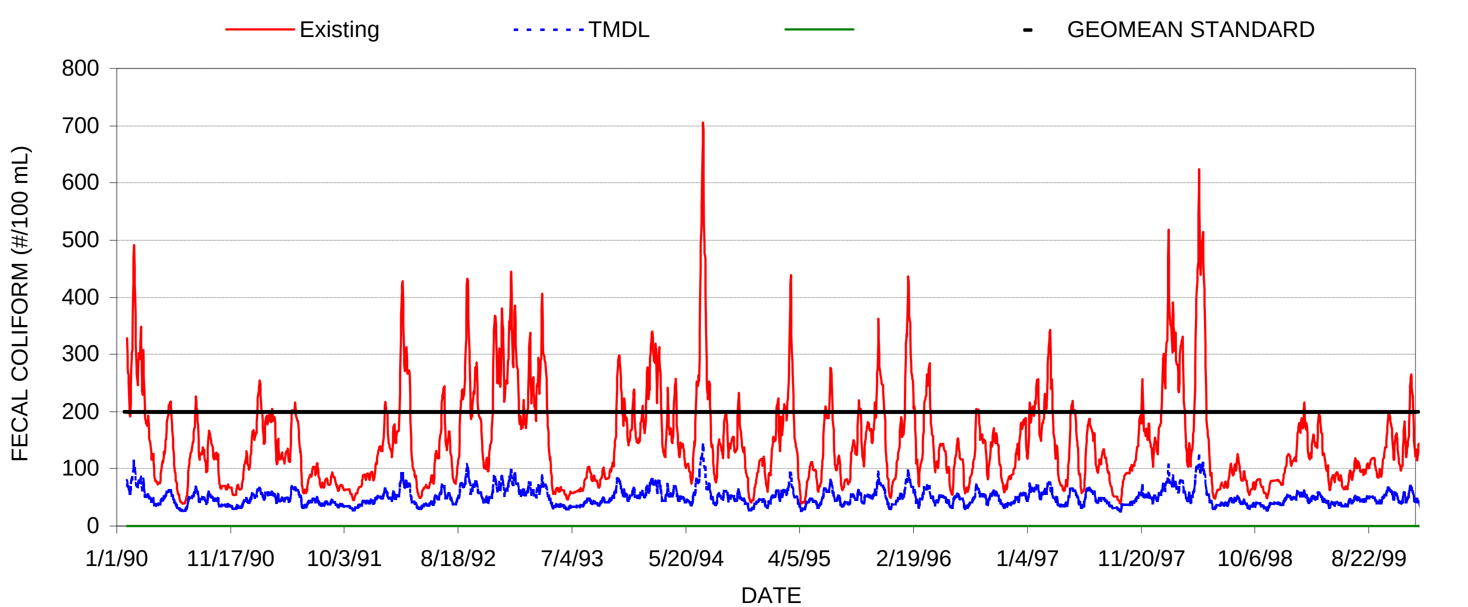
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Oconee R (to Lake Oconee)



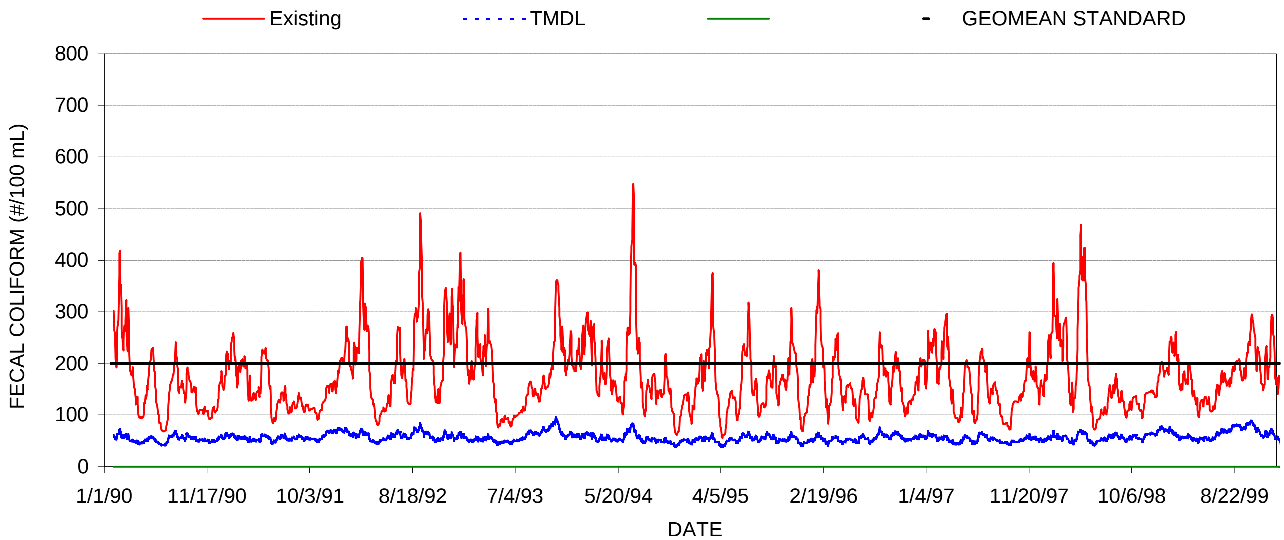
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Apalachee River (to Lake Oconee)



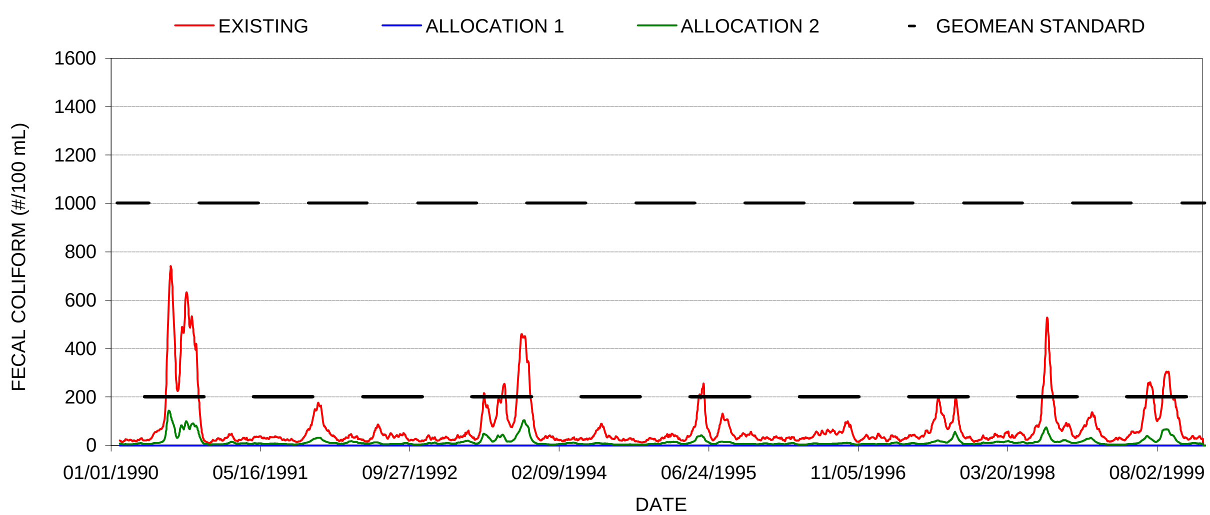
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

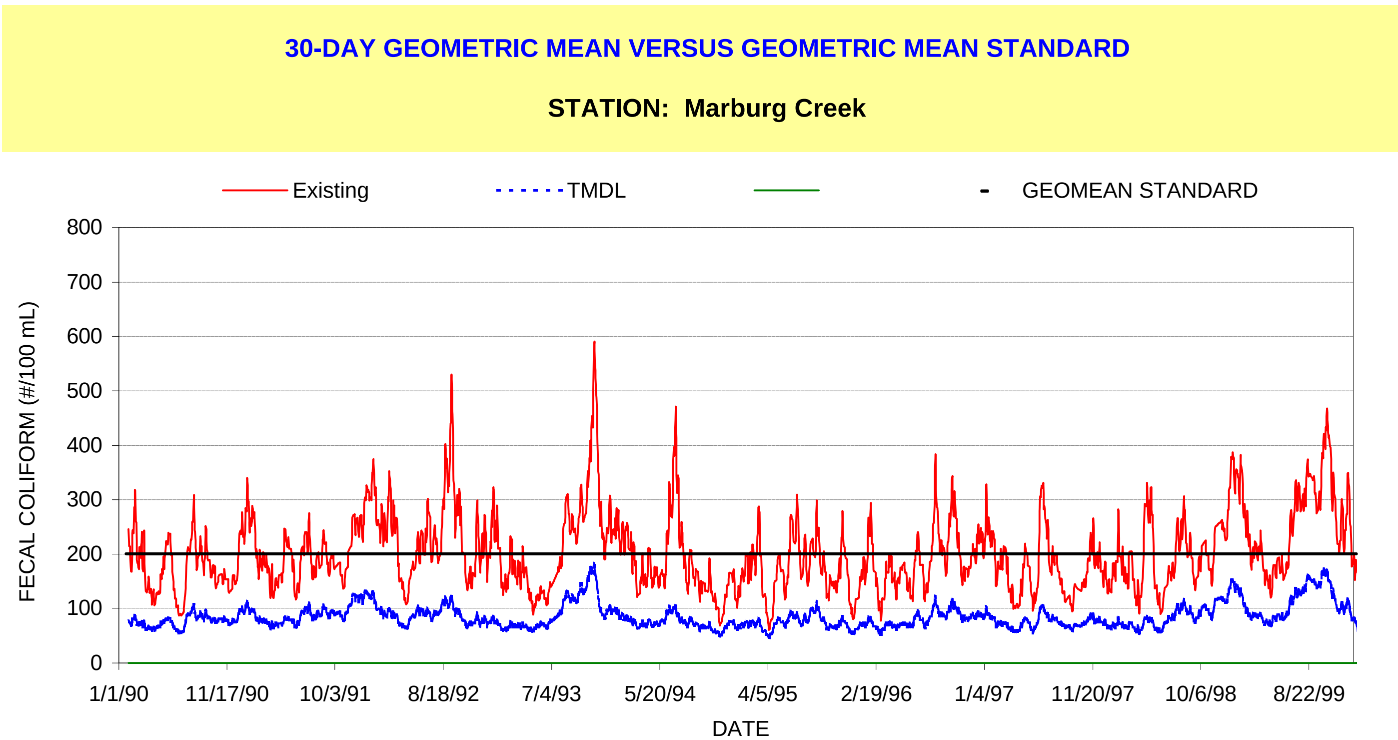
STATION: Apalachee River (to Marburg Cr)

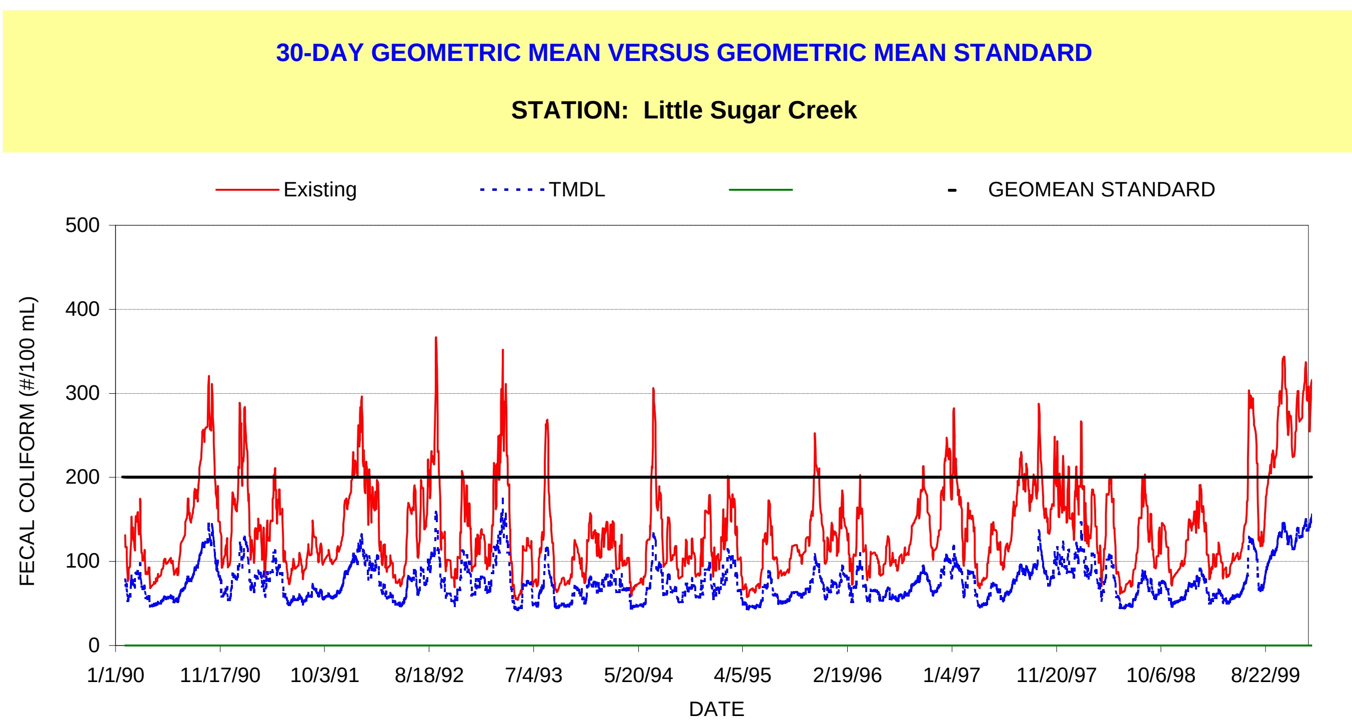


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Turkey Creek, Rocky Creek to Oconee River; Lower Oconee Basin

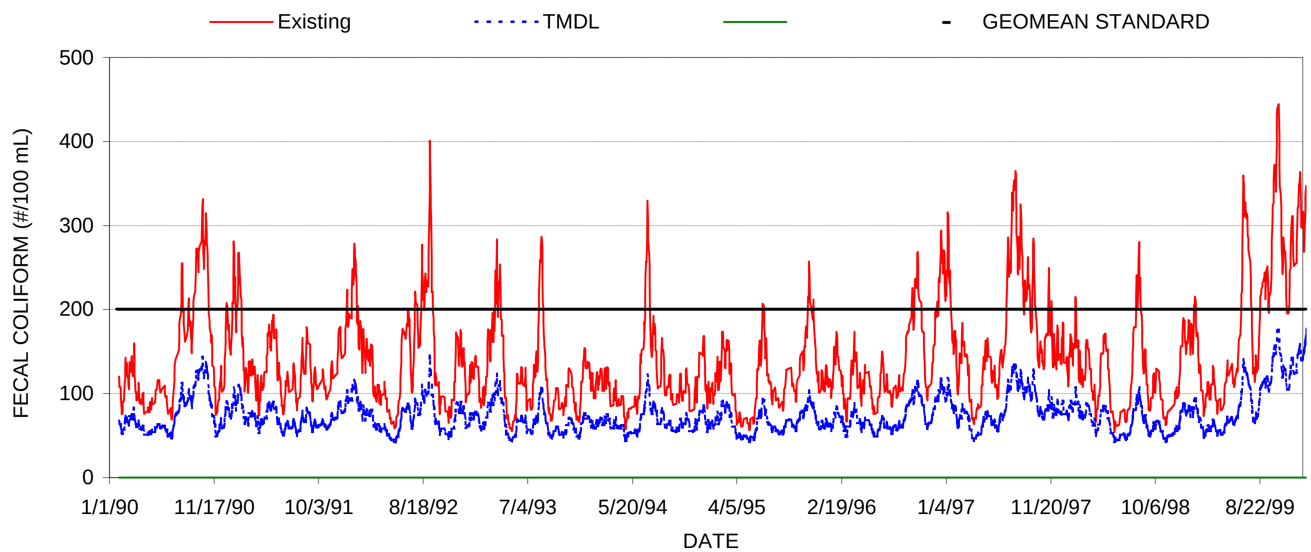



30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: Marburg Creek
Existing
TMDL
GEOMEAN STANDARD
FECAL COLIFORM (#/100 mL)
800
700
600
500
400
300
200
100
0
1/1/90
11/17/90
10/3/91
8/18/92
7/4/93
5/20/94
4/5/95
2/19/96
1/4/97
11/20/97
10/6/98
8/22/99
DATE


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: Little Sugar Creek
Existing
TMDL
GEOMEAN STANDARD
FECAL COLIFORM (#/100 mL)
500
400
300
200
100
0
1/1/90
11/17/90
10/3/91
8/18/92
7/4/93
5/20/94
4/5/95
2/19/96
1/4/97
11/20/97
10/6/98
8/22/99
DATE

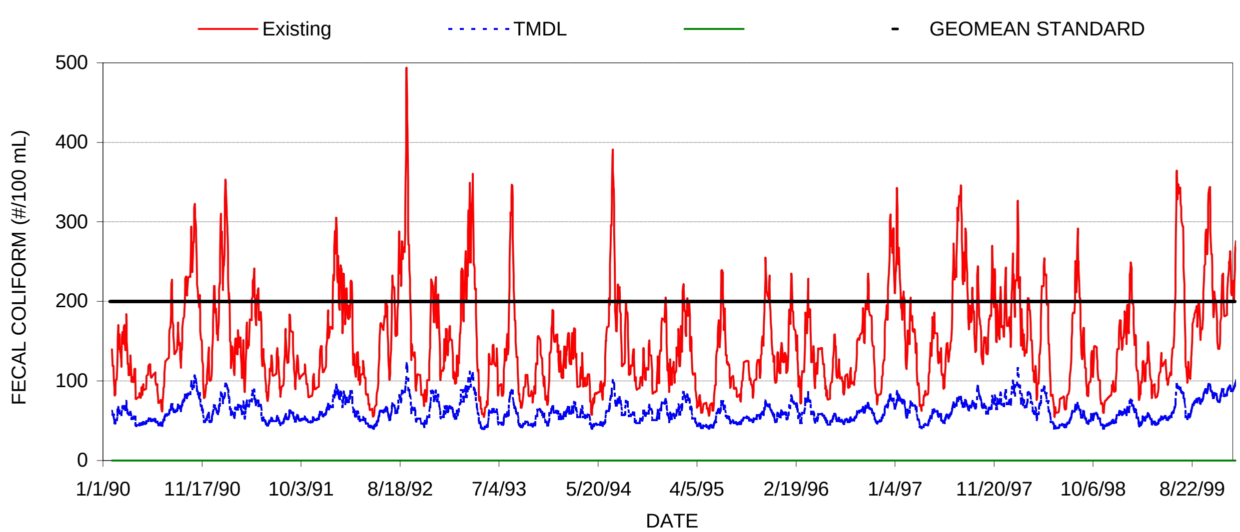
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Beaverdam Creek (to Lake Oconee)



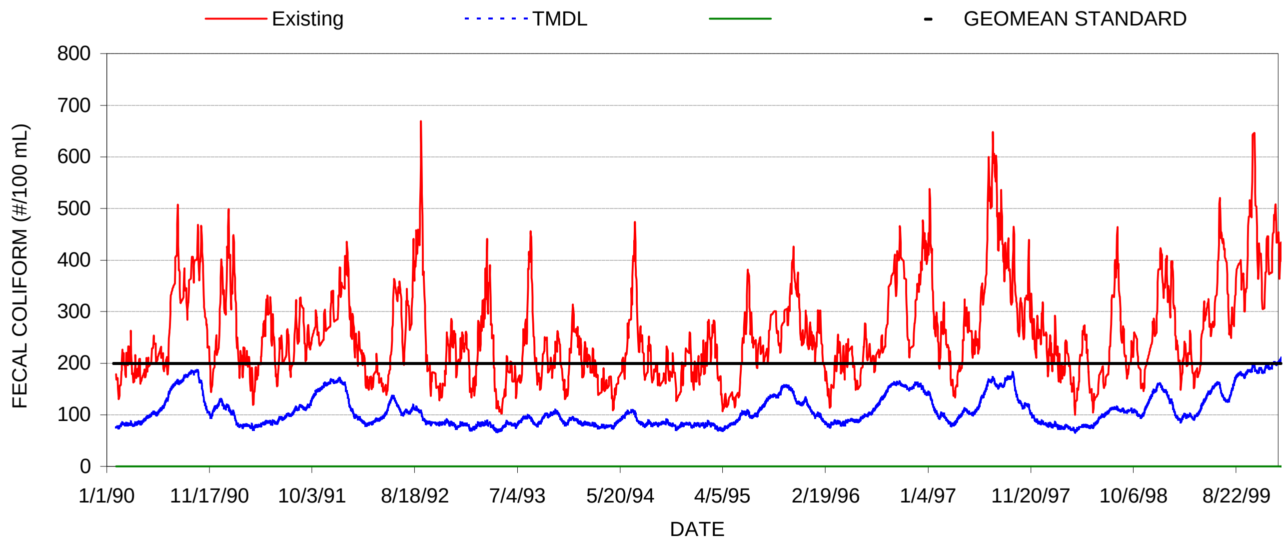
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Richland Creek (to Beaverdam Cr)



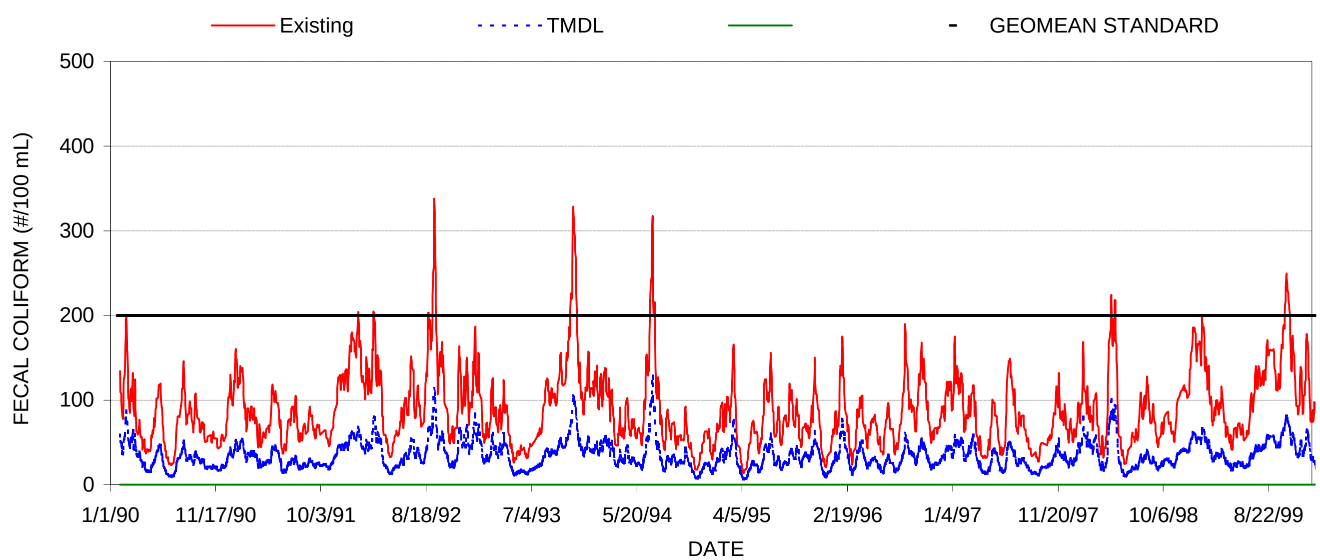
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Town Creek (to Richland Cr)



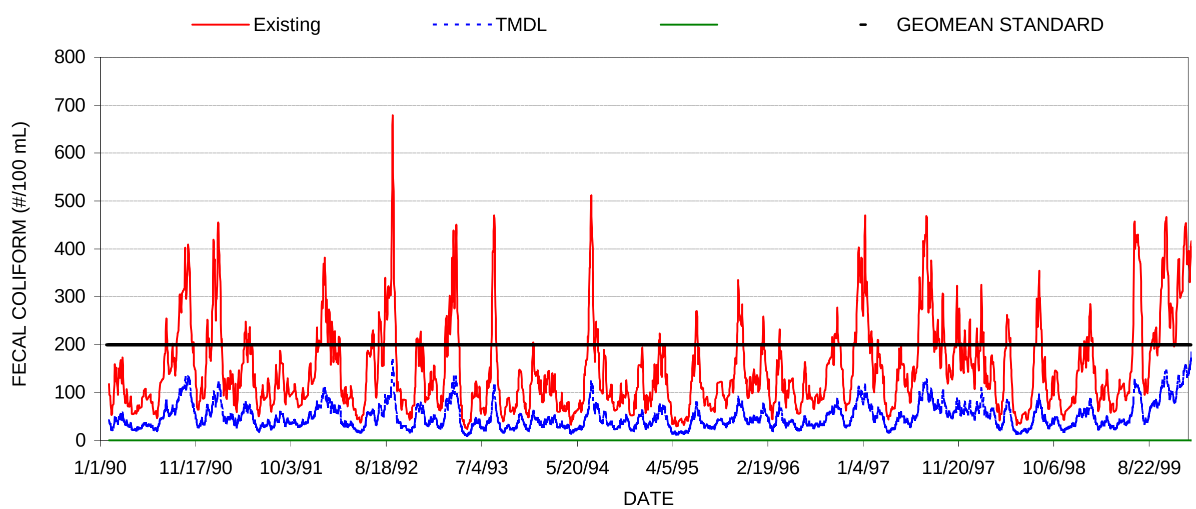
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Big Indian Creek



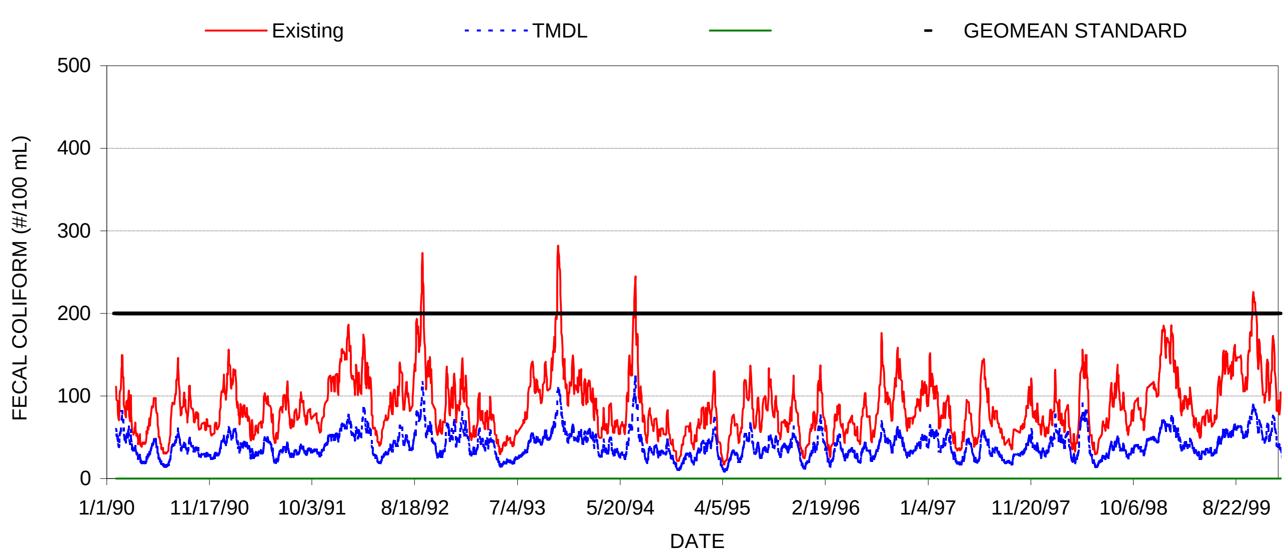
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Rooty Creek



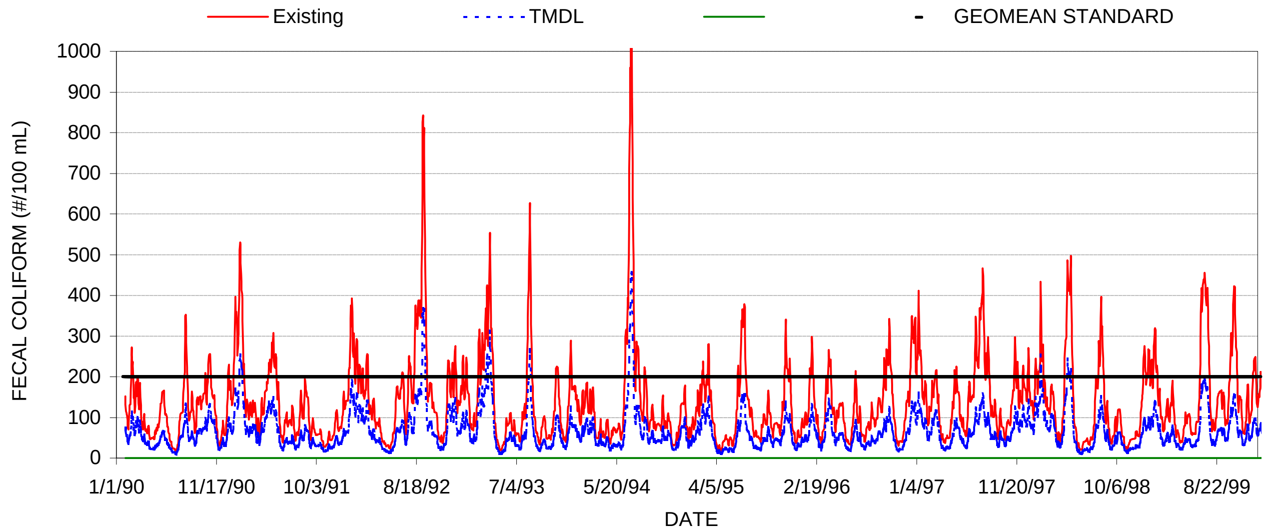
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Little River (to Nelson Cr)



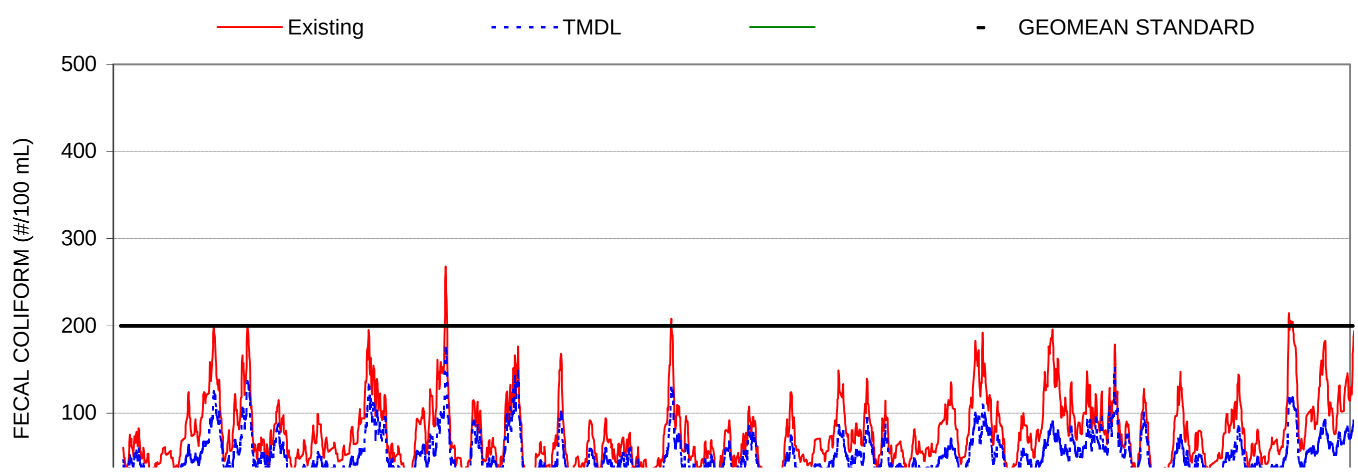
30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

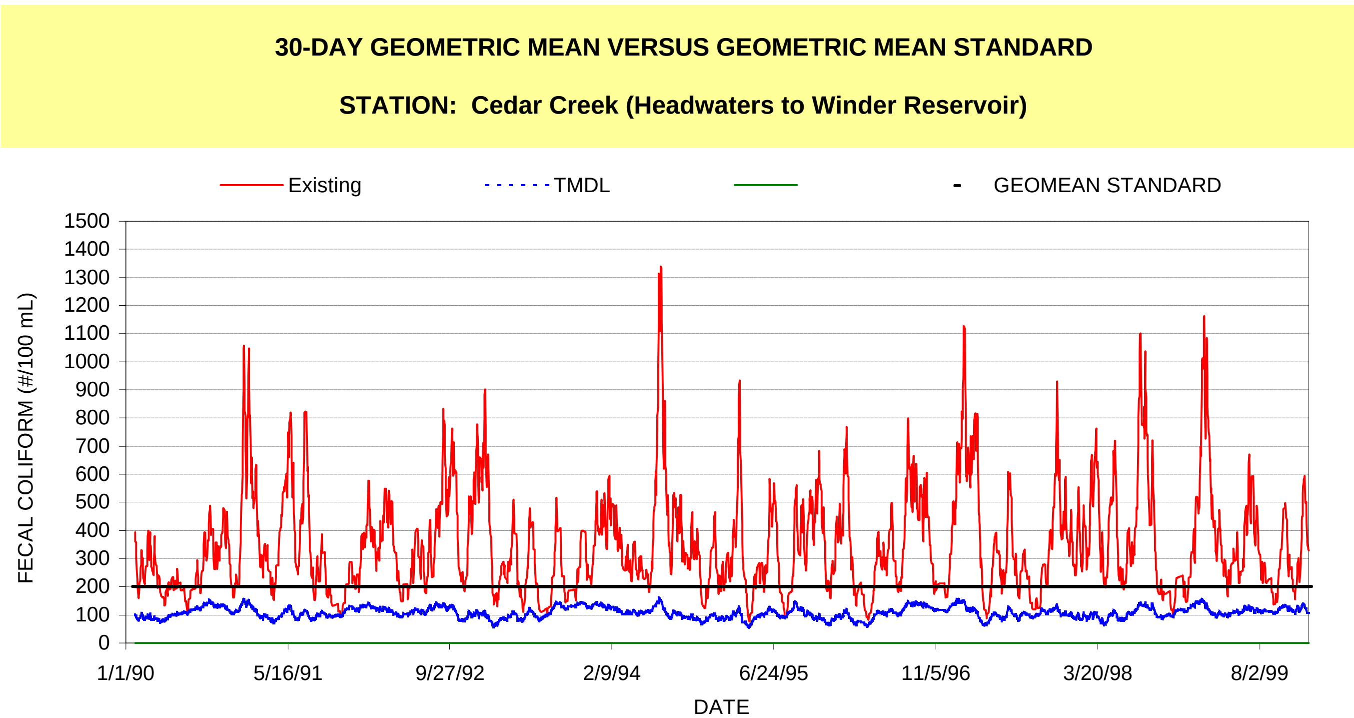
STATION: Little River (to Lake Sinclair)

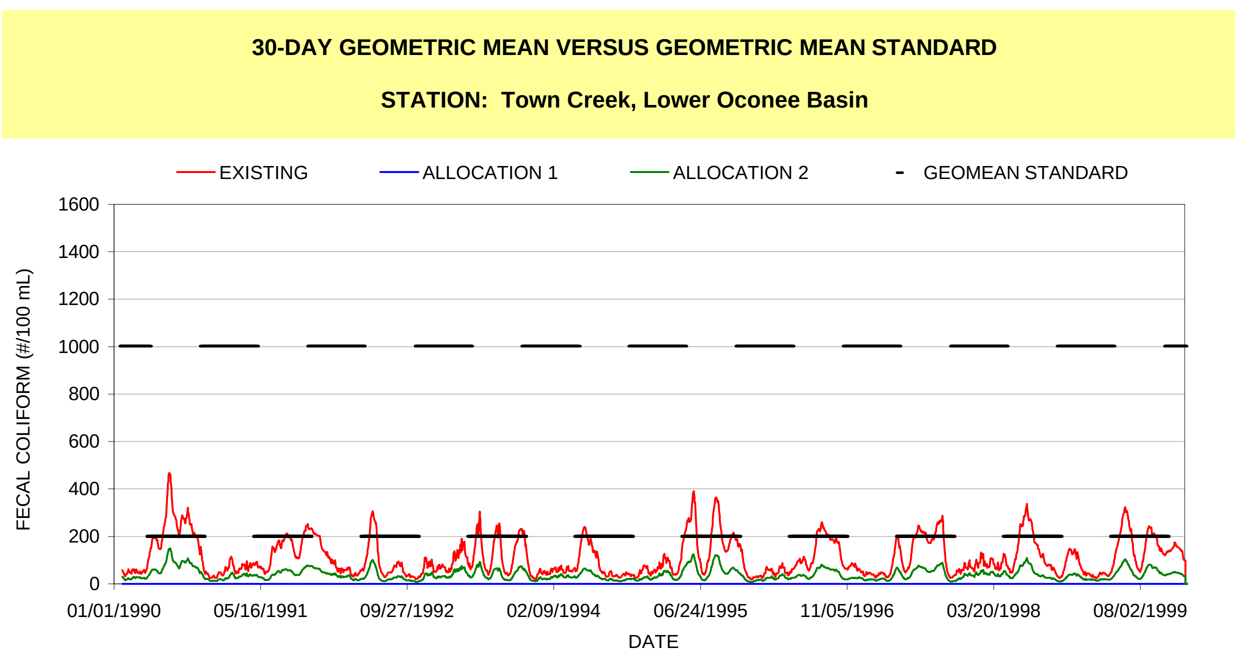


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Big Cedar Creek

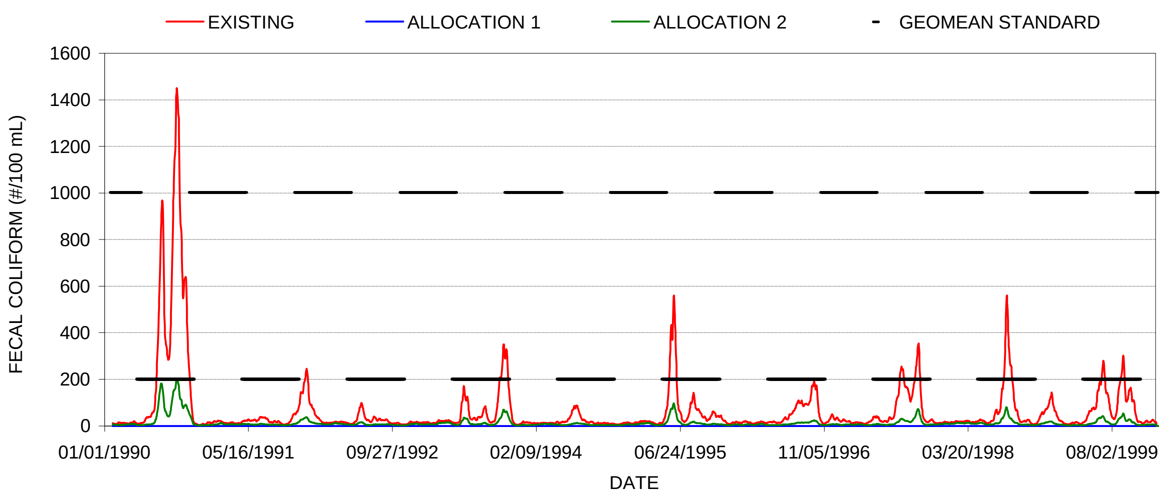



30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: Cedar Creek (Headwaters to Winder Reservoir)
Existing
TMDL
GEOMEAN STANDARD
FECAL COLIFORM (#/100 mL)
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1/1/90
5/16/91
9/27/92
2/9/94
6/24/95
11/5/96
3/20/98
8/2/99
DATE


30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD
STATION: Town Creek, Lower Oconee Basin
EXISTING
ALLOCATION 1
ALLOCATION 2
GEOMEAN STANDARD
FECAL COLIFORM (#/100 mL)
1600
1400
1200
1000
800
600
400
200
0
01/01/1990
05/16/1991
09/27/1992
02/09/1994
06/24/1995
11/05/1996
03/20/1998
08/02/1999
DATE

30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Big Sandy Creek, Lower Oconee Basin



30-DAY GEOMETRIC MEAN VERSUS GEOMETRIC MEAN STANDARD

STATION: Turkey Creek, Horse Branch to Rocky Creek; Lower Oconee Basin